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CONTENTS

JUDGMENTAL RESPONSE SETS IN THE PERCEPTION OF SOCIOMETRIC STATUS[1, 2]

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THE PROBLEM

In recent years much interest has been manifested in the processes involved in the social perception of one's relative standing in the group in which one holds membership (1, 2, 6, 11, 15, 19). A review of pertinent literature appeared in this journal recently (3a).

Studies of this problem have concerned themselves with relating accuracy of social perception to leadership ability (4), and to clinical (8) and social effectiveness (10). Accuracy of social perception has been operationally defined in these studies as the ability to predict sociometric status, attitudes, traits or self-concepts of others. The findings of these several investigators, however, do not suffice to support the hypothesis that accuracy of social perception is positively related to effectiveness in interpersonal relationships. Other aspects of this perceptual ability, therefore, warrant investigation. Awareness of own and others' status and of others' attitudes or traits may be influenced by tendencies in an individual: (a) to make constant errors of prediction or estimation (i.e., consistent under- or over-estimation of self or others), (b) to reciprocate his own expectations, and (c) to perceive himself as more or less accepting of others than other individuals in the group are. These influences in part will determine an individual's ability to accurately predict the relative degree of acceptance or rejection accorded the component members of the group (including himself) by the other group members.

Since it would be very helpful to have measures of these perceptual-judgmental response sets, a major aim of this study is to evolve such measures. Another purpose is to develop variations of existing methods of research on social perception. A third purpose of the present research is to study the way in which an individual perceives his fellow group members and is in turn

[1] This paper is a condensation of a Ph.D. dissertation submitted to the Graduate College of the University of Illinois, Urbana, Illinois, May, 1953.

[2] Sociometric status is the degree of acceptance-rejection afforded each individual by the members of his group. Perception of sociometric status refers to an individual's awareness of how well each member of the group, including himself, is accepted by all the other group members.

perceived by them, and to ascertain how these perceptual dimensions relate to general adjustment level, status within the group, accuracy of social perception, and feelings of anxiety and self-regard.

Specifically the problems which this study is concerned with are:

1. To investigate perceptual-judgmental sets which are reflected in the sociometric perceptions of individuals. This includes such variables as the tendency: (a) to consistently under- or overestimate in the perception of one's own and others' status; (b) to consistently perceive oneself as reciprocating or not reciprocating the sociometric ratings one expects from others; (c) to consistently perceive oneself as a very accepting or unaccepting individual.
2. To determine the stability and generality of these various perceptual dimensions and their relation to accuracy of perception of own and others' social status.
3. To determine the relationships between these perceptual-judgmental traits and: (a) perceptual judgments in related areas; (b) general adjustment; (c) anxiety; (d) sociometric status; (e) feelings of self-regard; and (f) belongingness in the group.

PROCEDURE

Population

The population consisted of 141 high school students from the University High School in Urbana, Illinois. The entire junior and senior class of 1950-51 and the junior class of 1951-52 were used. Socio-economic status for the group as a whole was above average. The parents of the University High School students are for the most part professional persons, a large percentage of whom hold academic appointments in the University of Illinois. Entrance into the school, however, is unrestricted, except for the payment of a nominal tuition fee. The mean age of these students was 16.2 years. The sex distribution was 55 boys and 86 girls.

Method

Several types of instruments were used to obtain measures of sociometric status, sociempathic ability, various perceptual sets used in estimating sociometric status, personality adjustment and level of aspiration. These instruments will be described below.

The sociometric perception scale consisted of space for identification information (e.g., name, age, sex, date, class), and three lists of the names of all the pupils in the class. The texts of the sociometric questions were:

Next to each student's name you are to place a number from one to five. "One" means you do not want this student to be your friend at all.

"Two" means that you would not like to have this student as a friend. "Three" means that you do not care whether or not this student is your friend. "Four" means that you would like to have this student as your friend. "Five" means that you would like to have this student as one of your best friends.

Scale instructions for the second list were comparable to those indicated above but reflective of ratings expected from others, (i.e., "one" means that you think, "This person does not want me as a friend at all").

List three required each student to rate each of his classmates in terms of popularity in the class. The instructions were: "One" means that you think this student is one of the least popular students in the class, that he is one of the students with the fewest friends. The complete scale was described in similar vein, "five" indicating the most popular persons, "three" the average persons, "two" and "four" those of less or more than average popularity but not selected as least or most popular. (For a complete account of the text used and administration of the test see reference 2, pp. 114-115.)

A sociometric status score and six discrepancy scores were derived from this scale.

Sociometric Status. The sociometric status score indicates how each student is actually rated by his classmates. This score was obtained for each student from the data on page two of his classmates' booklets where each student rated every other student in terms of acceptance-rejection on a five-point scale. The sociometric status score is the mean of all the ratings which each student receives from his classmates. A high score indicates high sociometric status or acceptance. A low score indicates low sociometric status or rejection. The sociometric status score pattern shows the general nature of the social structure of the group. It is a function of "tele" (15), a reflection of the mutual attraction between one individual and each of the other members of the group.

Sociempathic Ability. Two measures of sociempathic ability—accuracy in perceiving own and others' sociometric status—were obtained:

(a) *The "self-accuracy"* score was obtained for each individual by summing the discrepancies (without regard to sign) of his predictions of how others would rate him (page three of his sociometric scale) from the actual ratings given him by these persons (page two of the sociometric scale of his classmates). This score is a measure of one aspect of sociempathy—ability to perceive one's own sociometric status within a group in which one holds membership. Low self-accuracy scores indicate accuracy in perceiving one's own status in the group.

(b) *The "other-accuracy" score* was derived for each student by summing the discrepancies (without regard to sign) between all of the individual predictions made by a subject of the sociometric status of the other members of his group (page four of the sociometric scale) and the corresponding sociometric status scores (see above) of the latter. This score is a measure of a second aspect of sociempathy—ability to perceive the sociometric status of other members of one's group. Low other-accuracy scores indicate accuracy in perceiving the status of others.

Perceptual Sets in Estimating Sociometric Status. Four different scores, reflective of different aspects of perceptual set in predicting sociometric status, were obtained:

(a) *The "self-direction" score* is a measure of an individual's tendency to consistently[3] under- or overestimate in predicting his own sociometric status in the group of which he is a member. The self-direction score is a discrepancy score obtained for each student by algebraically summing the differences between the student's predictions of how each of the persons in the class will rate him (this data is taken from page three of the sociometric scale for each pupil) and the actual ratings he receives from his classmates (this data is taken from page two of the sociometric scales of his classmates). A high *positive* self-direction score indicates that an individual consistently tends to overestimate his own sociometric status. A high *negative* self-direction score indicates that an individual consistently tends to underestimate his own sociometric status. Scores approaching zero (low positive or low negative scores) indicate that an individual does not consistently tend to make extreme estimates of his own status in either direction.

(b) *The "other-direction" score* is a discrepancy score obtained for each student by algebraically summing the discrepancies between the student's predictions of the mean sociometric ratings, which his classmates will receive from the group (this data is obtained from page four of his sociometric scale) and their actual sociometric status. The other-direction score is a measure of the tendency for an individual to consistently under- or overestimate in predicting the sociometric status of other members of the group. High *positive* other-direction scores indicate a consistent tendency to over-

[3] Consistent under- or overestimation is defined in terms of total discrepancy score. This leaves open the possibility that some individuals could make a high score by just making a few very high estimates in one direction which counteract a larger number of small estimates made by them in the opposite direction. This was true, however, of only 2% of the population. The remainder in each extreme group are those who make a high proportion of estimates in the direction indicated.

estimate the sociometric status of others. High *negative* scores indicate a consistent tendency to underestimate the sociometric status of others. Scores approaching zero indicate no consistent tendency to over- or to underestimate the status of others.

(c) *The "reciprocity" score* is a measure of an individual's tendency to perceive himself as under- or over-reciprocating the acceptance tendered him by other members of the group. The reciprocity score was derived by algebraically summing the differences between the ratings which each student gave to his classmates (page two of the sociometric scale) and his predictions of how each of his classmates would rate him (page three of the sociometric scale). High *positive* reciprocity scores indicate that one consistently gives higher ratings to others than the ratings one expects to receive from others. High *negative* reciprocity scores indicate that one consistently gives lower ratings to others than one in turn expects to receive. Scores approaching zero indicate a tendency to give others the same ratings that one expects to receive from them.

(d) *The "acceptance" score* was derived by algebraically summing the differences between the student's sociometric ratings of his classmates (page two of the sociometric scale) and his predictions of the sociometric status of his classmates. The acceptance score is a measure of an individual's tendency to perceive himself as more or less accepting of others relative to his perception of the group's acceptance of others. High *positive* acceptance scores indicate that one consistently perceives oneself as more accepting of others than the group is. High *negative* acceptance scores indicate that one consistently perceives oneself as less accepting of others than the group is.

Measures of Personality Adjustment

The Minnesota Multiphasic Personality Inventory Score. Standard instructions were used for the administration and scoring of the Minnesota Multiphasic Personality Inventory (12).

To derive total adjustment scores from the Minnesota Multiphasic Personality Inventory, raw scores on each of the subscales were first converted into standard scores. Since a positive standard score on a given subscale indicates a degree of deviancy with respect to the trait measured that is greater than the mean of our particular population, we were able to obtain an indication of total personality deviancy for each individual by summing all of his positive standard scores on the various subscales. In the case of the masculinity-femininity scale, since a negative standard score is indicative of inappropriateness relative to sex role, it (rather than a positive standard

score) was added to the other subscale standard scores to obtain the M.M.P.I. adjustment score. The higher M.M.P.I. scores, therefore, are indicative of relatively poorer personality adjustment.

Rorschach Adjustment and Anxiety Scores. The administration of the Rorschach Group Test followed the procedure developed by Harrower and Steiner (13). The scoring of the records was in accord with the modified scoring system developed by Klopfer and Kelly (14). Each protocol was systematically surveyed through the use of the comprehensive and relatively objective check-list devised by Munroe (16). This check-list provides criteria for a "normal" range for each type of response determinant. Entries in the checklist are made whenever the subject's performance deviates from the normal range. The sum of these entries provides an adjustment rating score. Hence, a high Rorschach adjustment score is indicative of poor adjustment.

The Rorschach anxiety score was derived by crediting a subject with one point for each anxiety sign[4] manifested in his test booklet. High Rorschach anxiety scores are indicative of a relatively high degree of anxiety, and vice versa.

Teachers' Ratings of Adjustment. The teachers of the junior and senior classes were asked to rate their students on personal adjustment (integration, balance, emotionality, home relationships) on a 5-point scale (excellent to poor). (The mean intercorrelation between the ratings of six teachers was

[4] The following Rorschach "signs" were used as a guide in determining the anxiety rating for each subject (3, 7, 14).

1. The total number of card rejections (rej.).
2. The percentage of responses: (a) to the whole card (W); (b) of oligophrenic details (O); (c) of unusual details (Dd); (d) using human movement (M); (e) using form as a sole determinant, and the quality of the form (F+, F—).
3. Diffuse shading response (K, KF, kF).
4. The ratio of human detail to complete human figure responses; the ratio of human detail and animal detail to human and animal responses (Hd:H; Hd+Ad:H+A).
5. Content analysis: Threatening, vague, evasive responses, noncommittal comments, etc.
6. Signs of shading shock (Sh. S.); Impoverished content, decline in form quality, irregular succession, avoidance of use of texture as a determinant, decrease in ability to see popular (P) responses, etc.
7. Color balance (FC:CF+C).

.64,[5] indicating a fair degree of reliability). The ratings of five teachers on each pupil, were then averaged to give a teachers' adjustment rating score.

Composite Adjustment Score. The M.M.P.I., Rorschach and teachers' adjustment scores, each in the form of standard scores for the population tested, were averaged to provide a composite adjustment rating score for each student.

Level of Aspiration Measures

Laboratory Measures. Three paper-and-pencil, level of aspiration tests (speed of reading, arithmetic and digit symbol) were administered individually to each pupil by the investigator. In order to secure ego-involvement, tests presenting tasks with academic connotations were selected, and the importance of the skills involved in these tasks for a wide variety of academic and vocational situations was explained to the subjects.

Speed of reading was measured by the number of sentences a student was able to complete on Form II of the Michigan Speed of Reading Test in a trial of 90 seconds.

The arithmetic test consists of four pages, each of which contains 144 one-place addition and subtraction examples. The subject attempts to complete as many examples as he possibly can on each page (trial) in the course of 60 seconds.

The digit-symbol test requires the subject to substitute geometric symbols for numbers (1-9) in accordance with a code which is presented with the material. The test consists of four pages requiring 100 substitutions. The time limit for each page (trial) is 60 seconds.

The reading, arithmetic and digit symbol tests are all speed rather than power tests. They involve simple tasks of approximately uniform difficulty. Four trials, each with the same time limit, were given for each task. An adequate ceiling, in terms of number of units presented for the stated time limits, was provided so that no individual in the population could complete all units for a given trial.

In each of the three paper-and-pencil tests, level of aspiration for the *first* performance was ascertained after exhibiting the material and explaining the conditions of the test. The subject was asked:

> How many sentences (examples, units) like this do you think you could do in 90 (60) seconds? Make the very best estimate you can.

[5] Mean intercorrelations were obtained by transforming each r into corresponding Fisher's Z coefficients, finding the arithmetic mean of the Z's and converting the mean Z back to the corresponding r.

After the first performance, the subject was told his score and was asked to predict his score on the second trial. This procedure was repeated until four trials were completed. A prediction for the fifth trial was obtained, but a fifth trial was not administered.

Two types of discrepancy scores were derived from reported performance and level of aspiration: (a) goal discrepancy scores and (b) goal tenacity scores.

(a) *The goal discrepancy score* in each instance was determined by subtracting the reported score on a given trial from level of aspiration for the immediately succeeding trial. Thus, four goal discrepancy scores were available for each type of test material without making use of the initial level of aspiration obtained prior to performance on the first trial. The goal discrepancy scores were converted into standard scores for each type of test material treated separately. These standard scores were then averaged to provide a composite goal discrepancy score or measure of level of aspiration for each individual. A high composite goal discrepancy score indicates that an individual tends to maintain striving at a high level in relation to previous performance or that he is relatively optimistic in predicting future performance on the basis of past performance.

(b) *The goal tenacity score* refers to the relationship between the goal discrepancy score and feelings of success or failure emanating from the previous performance. These feelings are defined operationally in terms of the *performance discrepancy score,* or the difference between actual performance and the prior level of aspiration for it. Four goal tenacity scores were derived. This was done by algebraically subtracting from each goal discrepancy score the preceding attainment discrepancy. This latter discrepancy (indicative of feelings of success or failure in relation to past performance), in turn, was calculated by subtracting from each performance (including the first trial) the preceding level of aspiration for that performance. A high composite goal tenacity score indicates that an individual tends to maintain striving at a high level in relation to previous feelings of intra-serial success or failure, or that he is relatively optimistic in predicting future performance on the basis of previous success and failure experiences.

Academic Goal Discrepancy. Upon the completion of this testing session each student was asked to predict the grade-point average he would receive at the end of the current semester. The discrepancy between this prediction and the student's composite grade-point average prior to the current semester was used as an index of academic level of aspiration.

In addition to the descriptions and definitions of scores given above, the following sub-groups may be defined:

(a) *Self-underestimators* are those individuals who obtain high *negative* self-direction scores. They consistently tend to underestimate their own sociometric status in relation to their actual status.

(b) *Self-overestimators* are those individuals who obtain high *positive* self-direction scores. They consistently overestimate their own sociometric status in relation to their actual status.

(c) *Other-underestimators* are those subjects who obtain high *negative* other-direction scores. They consistently underestimate the sociometric status of others relative to their actual status.

(d) *Other-overestimators* are those subjects who obtain high *positive* other-direction scores. They consistently overestimate the sociometric status of others relative to their actual status.

(e) *Under-reciprocators* are those subjects who obtain high *negative* reciprocity scores. They consistently tend to perceive themselves as less accepting of others than others are of them.

(f) *Over-reciprocators* are those subjects who obtain high *positive* reciprocity scores. They consistently tend to perceive themselves as more accepting of others than others are of them.

(g) *Under-acceptors* are those subjects who obtain high *negative* acceptance scores. They consistently tend to perceive themselves as less accepting of others than the group is.

(h) *Over-acceptors* are those subjects who obtain high *positive* acceptance scores. They consistently tend to perceive themselves as more accepting of others than the group is.

In succeeding portions of this paper we shall refer to the measures of the four different perceptual sets in estimating sociometric status as our *major* independent variables. Measures reflective of sociempathic ability (accuracy in perceiving sociometric status) will be considered as subsidiary independent variables. The major dependent variables are: (a) level of aspiration measures designed to test the generality of perceptual sets in estimating sociometric status in another area of judgment (i.e., the estimation of future performance in relation to the quality of previous performance and in relation to previous feelings of success and failure); (b) measures of personality adjustment; and (c) sociometric status.

RESULTS

The Independent Variables

Reliability

The reliability coefficients (split-half method, corrected) of the major independent variables are quite high. For the self-direction score r = .94, for the other-direction score .88, for the reciprocity score .97, and for the acceptance score .92. These are of the same order of magnitude as those generally found by previous investigators using similar types of measures (1, 2, 6, 9). These findings indicate that the perceptual personality traits investigated in this study have sufficient stability (i.e., generality over persons) despite their heterogeneous nature, not only for personality research, but also for purposes of prediction in individual cases.

Interrelationships between the Major Independent Variables Eestimation of Own Sociometric Status. The intercorrelations between the major independent variables indicate a significantly better than chance relationship between the self-direction scores and both the reciprocity and acceptance scores. Self-direction correlated negatively with reciprocity (— .32**),[6] and positively with acceptance (.36**). These correlations show that those who consistently *overestimate* their own sociometric status tend to expect that they will receive higher ratings from others than they themselves are willing to give. Such persons also tend to perceive themselves as more accepting of others than other individuals in the group are or as more generous than the group in accepting others. That is, self-overestimators perceive themselves as both highly accepting of others and as highly acceptable to others. This is in line with Sheerer's (18) finding that persons who accept themselves tend more to accept others. On the other hand, those who consistently *underestimate* their own sociometric status tend to expect *lower* ratings from others than they in turn give, and they see themselves as *less* accepting of others than the group. That is, self-underestimators perceive themselves as both not very accepting people and as less acceptable to others, and perceive other group members as more accepting than they really are.

Estimation of Others' Status. The correlations obtained between the other-direction scores and both reciprocity and acceptance were significant but in a direction opposite to those found between the latter variables and estimation of own status. Other-direction scores correlated positively with reciprocity scores (.29**) and negatively with acceptance scores (— .41**).

[6] ** r significant at the 1% level of confidence or better.

These correlations show that those who consistently *overestimate* the sociometric status of others have the same pattern of perceptual intercorrelations as self-*under*estimators. They tend to have low expectations for self and to perceive themselves as less accepting of others than other individuals in the group are. Other-*underestimators,* on the other hand, have high self-expectations and perceive themselves as more accepting of others, as did the *self-over*estimators.

A reasonable inference that might be drawn from the above findings of similar social perceptual patterns between self-underestimators and other-overestimators might be that feelings of low self-regard are associated with a consistent tendency to both underestimate self and to overestimate others. This inference of low self-regard is made more tenable by the fact that both these groups have low self-expectations, i.e., tend to expect lower ratings of acceptance from others than they give in return. It would seem that rather than reciprocating in actuality the low ratings they expect from others, these individuals project their perception of self as less acceptable to others by perceiving themselves as less accepting than others. The fact that they perceive the group as more accepting than they are might also mean that they perceive the group to be overly accepting in relation to everyone else but themselves.

Those individuals who do not consistently over- or underestimate in predicting either their own or others' status, or who do not do so to any appreciable extent, tend most to give ratings similar to those they expect to receive, and to perceive themselves as neither more nor less accepting of others than the group is. Hence, they seem to differ from the extreme over- or underestimators of self and others' status in being guided more by what they perceive as the group's norms in rating others (including themselves). That is, they use what they perceive as the group norm as a reference frame upon which to base their ratings of others rather than the personal judgments which the two preceding groups use. The individuals in this middle group of the direction score distribution are more influenced in their ratings of self and others by their *perceptions* of how others feel; whereas the two extreme groups of the direction score distribution are guided more in their ratings of self and others by internal aspirational needs, by self-perceptions, and by their own individual affective reactions to people. The extreme groups are presumably more independent and less group-suggestible than the middle group is in their affective responses to associates.

The intercorrelations of the four major independent variables indicate that a different perceptual trait is probably being measured by each of the

two direction scores, and that the reciprocity and acceptance scores, too, are independent of each other. The low and not significant correlation between the self-direction and other-direction scores (.12) suggests that an individual's tendency to consistently make relatively high or low predictions in estimating his own sociometric status stems from other source traits or different need patterns than does the tendency to consistently over- or under-predict in estimating the sociometric status of others. This also appears to be true of the determinants underlying perception of self as an accepting (acceptance score) and as an acceptable (reciprocity score) person, since the correlation between reciprocity and acceptance scores (.04) too was low and not significant.

The analysis of these independent traits, by a comparison of the means of the extreme score groups on each variable (Table 1), confirmed the relationships found between the direction scores and both the reciprocity and acceptance scores in the preceding correlational analysis made for the entire population.

Relationships between the Direction Scores and Sociempathic Ability. Low accuracy scores indicate little error in predicting sociometric status or high sociempathic ability. On the other hand, low direction scores indicate consistent underestimation of sociometric status whereas high direction scores indicate consistent overestimation of sociometric status. Thus the significant correlations between the self- and other-accuracy scores and the self- and other-direction scores (.55** and .37**, respectively), mean that those who are most accurate in the perception of own sociometric status tend to underestimate in predicting their own status; and those who are most accurate in the perception of others' status tend to underestimate in predicting the status of others.

Although an explanation of the relationship between over- or underestimation of others' status and sociempathic ability is not immediately apparent, some conclusions can be drawn with respect to self-under- and overestimation and sociempathic ability. Self-overestimators, as indicated above, perceived themselves as highly accepting and as highly acceptable persons. In addition, they tend to set higher levels of striving for themselves than did self-underestimators, and they tended to maintain these levels even in the face of failure experiences. In general, therefore, they present a picture of expansiveness in which more is expected than objective reality warrants. Their perceptual or judgmental set is distorted by strong ego needs for success and for acceptance by others.

Self-underestimators, however, perceived themselves not as very accept-

TABLE 1

SIGNIFICANCE LEVELS OF THE DIFFERENCES BETWEEN THE HIGH AND LOW GROUPS ON A GIVEN INDEPENDENT VARIABLE WITH RESPECT TO SCORES ON OTHER INDEPENDENT VARIABLES

High and Low Groups on a Given Independent Variable	Self-Direction Scores			Other-Direction Scores			Reciprocity Scores			Acceptance Scores		
	N	M	S.D.	N	M	S.D.	N	M	S.D.	N	M	S.D.
Self-Underestimators	19	—2.12	.42	19	.44	1.44	20	—.73	1.48	20	.78	.86
Self-Underestimators	19	—2.12	.42	19	.14	1.44	21	.31	1.0	21	—.44*	.96
Other-Underestimators	20	.04	1.14	20	—.98	1.08	20	—.14	.92	20	—1.01	.94
Other-Overestimators	20	.42	1.72	20	1.81*	.89	20	—.45	1.51	20	.91*	.91
Under-reciprocators	21	—.84	1.40	21	.13	1.61	23	—1.70	.87	23	—.18	1.22
Over-reciprocators	16	.27*	1.18	16	—.54	.42	17	1.31*	.46	17	.28	.88
Underacceptors	19	.66	1.02	19	—.30	1.13	21	—.27	.90	21	—1.68	.49
Overacceptors	22	—1.15*	1.10	22	.87*	1.36	23	—.26	1.44	23	1.44*	.39

An * placed between two means indicates that their difference is significant at the 1% level of confidence.

ing people and as on the giving end of relatioships. They adjust their aspiration level more readily and realistically in accordance with their performance and their feelings of success or failure. They thus tend to be less euphoric, more realistic and less motivated by ego-enhancement needs in making judgments of their own actual status than self-overestimators are.

Another possible explanation of the finding that self-underestimators make higher accuracy scores than self-overestimators is that it may be quite threatening for a student to admit that others do not accept him (give him a low status rating). Certainly it is easier to admit that one is accepted than not accepted. Hence we would expect that underestimators would not rate themselves as extremely at the low end of the rating scale as overestimators would at the upper. This inclination to minimize one's undesirable sociometric position and to maximize a desirable one could be the explanation of the greater accuracy obtained by the understimators. Cogan and Conklin (5) found that the greatest tendency toward overestimation occurs with respect to the most desirable traits. Therefore, since self-overestimation could be expected to overestimate their popularity (a desirable trait) to a greater extent that self-underestimators would tend to admit to unpopularity, they are understandably less accurate in perceiving and predicting their actual status.

Relationships between the Independent and Dependent Variables Relationships between the Independent Variables and Measures of Level of Aspiration. Evidence for the generality of the consistent self-prediction tendencies measured by the independent variables was sought by comparing the extreme score groups on these variables with respect to level of aspiration and goal tenacity scores. Significant differences between the mean level of aspirations and goal tenacity scores of the extreme groups were only obtained with respect to self-judgments (the self-direction and reciprocity groups.) A significant difference was obtained between the mean composite level of aspiration scores of the high and low self-direction groups ($t = 2.30$) and of the high and low reciprocity groups ($t = 2.94$). The high and low reciprocity groups also obtained significantly different mean goal tenacity scores ($t = 2.27$) (the above t values were each significant at the 1% level of confidence). These findings indicate that those individuals who consistently overestimated in predicting their own sociometric status, also overestimated in predicting their future performance levels on tasks presented to them. In addition, they tended to maintain higher levels of striving (though not significantly so statistically, $p > 10\%$) without much reference to fluctuations in the quality of their preceding performance.

Those who consistently maintained high self-expectations with respect to sociometric status (under-reciprocators), also overestimated their future performance levels on laboratory tasks and maintained their high levels of striving in the face of failure experiences to a significantly greater degree than those whose self-expectations were consistently low (over-reciprocators).

Since the composite level of aspiration scores and the composite goal tenacity scores both measure responses in several different task situations, the above findings may be interpreted as reflective of a generalized personality trend within an individual. Specifically, the personality (judgmental or perceptual trend measured by the self-direction, reciprocity, composite level of aspiration and goal tenacity scores may be conceptualized as a more or less typical or self-consistent way in which an individual tends to respond in making self-judgments based upon his perception of social or task situations.

Relationship between the Independent Variables and Measures of Adjustment. Comparison of the mean adjustment scores obtained by the high and low groups on the independent variables indicate that adjustment is not significantly influenced by an individual's perceptual-judgmental sets with respect to *others'* status and with respect to perceived acceptance tendencies in self and others. On the other hand, *self*-judgments were found to be significantly related to adjustment. Self-underestimators were found to have better adjustment scores than self-overestimators ($t = 2.58^*$) (Table 2).

Self-underestimators might conceivably be better adjusted than self-overestimators despite lower self-regard, because they are more realistic. This finding is in agreement with Chowdry and Newcomb's (4) conclusion that those individuals whose perceptions tend to be more realistic are more likely to achieve adequate adjustment. Since the self-underestimators were also more accurate in predicting their own status than the self-overestimators were, our results are consistent with Sheerer's (18) finding that better adjusted persons' self-estimates are closer to the groups' ratings than those of less well adjusted persons.

Under-reciprocators were found to have better adjustment scores than over-reciprocators ($t = 4.12^*$) (Table 2). This could be interpreted to mean that under-reciprocators have better adjustment despite their less realistic perceptions because of higher feelings of self-regard.

Relationship between the Independent Variables and Sociometric Status.

* r significant at the 5% level of confidence or better.

TABLE 2

SIGNIFICANT LEVELS OF THE DIFFERENCES BETWEEN THE HIGH AND LOW GROUPS ON THE INDEPENDENT VARIABLES WITH RESPECT TO MEASURES OF ADJUSTMENT

High and Low Groups on a Given Independent Variable	Measures of Adjustment: Composite Adjustment N	M	S.D.	Rorschach Adjustment N	M	S.D.	Rorschach Anxiety N	M	S.D.
Self-Underestimators	20	—.60	1.91	19	—.09	1.04	19	.10	.85
Self-Overestimators	21	.80*	1.43	19	—.02	1.24	20	.07	.90
Other-Understimators	20	.22	1.49	18	.40	.90	18	.10	1.36
Other-Overestimators	20	.48	2.25	18	.36	1.03	18	—.01	.94
Under-reciprocators	23	1.47	1.95	22	.59	1.18	23	.37	.92
Over-reciprocators	17	—.87*	1.55	16	—.26*	.75	17	—.15	.72
Underacceptors	21	.42	2.27	21	.14	1.22	21	.48	1.14
Overacceptors	23	—.30	1.49	21	.10	1.02	21	—.13	.87

An * placed between two means indicates that their difference is significant at the 1% level of confidence.

Self-underestimators obtained higher sociometric ratings than did self-overestimators. To an indeterminate extent this finding is partially an artifact. Individuals who have high sociometric status can only make predictions of own status which are either accurate or underestimations since their actual status is at or near the upper ceiling of the scale. On the other hand, those who have low status can be either accurate in their estimations of own status or overestimators since their actual status is at or near the lower ceiling of the scale. It is felt, however, that this finding does suggest a valid relationship when we consider that self-underestimators were also found to be more accurate in predicting their own sociometric status. Since self-underestimators are more realistic in their social perceptions, they are less likely to make unreasonable demands on others. Thus, they may be expected to approach others more successfully without offending them. Wood (20) also found that high school students tend to have higher sociometric status if they are more accurate in estimating their classmates' opinions. On the other hand, the more expansive, demanding self-overestimators, perceiving themselves as highly acceptable and highly accepting individuals, would tend to be more aggressive in their approach, and would, therefore, be more likely to antagonize others.

The high self-expectations of the self-overestimators might also reflect undue concern over the opinions of others and might thus account in part for their relatively lower sociometric status. For as Newstetter and New-

comb (17) have shown, individuals who are least concerned with the opinions people have of them tend to have higher status than those who are highly concerned with their own status.

Implications for Further Research

The results of the present study and of experimental findings by others point up the need for further research into the relationships between social sensitivity and such situational variables as group size and group composition, similarities between rater and ratee with respect to social-class status and social attitudes and the nature and function of the group (i.e., formal or informal, vocational or social, etc.).

The present investigation found consistencies in perception within one administration of the sociometric measures. It would be interesting to know if such consistencies are stable and general enough to be manifested over several administrations on the same group at different times in different activities, and in social, vocational and other types of groups.

The tendency toward extreme perceptual judgments was found to be related to strong motivational bias of a subjective nature. Further study of this problem would require extensive and longitudinal clinical investigation in order to identify the factors in personality development and organization which account for the perceptual differences found.

The finding that accuracy in perceiving own and others' status are unrelated traits suggests study of the perceptual patterns and personality correlates of groups (a) which have high empathic ability with respect to self and others, (b) which have poor ability with respect to both functions, and (c) which have high ability in one function and low ability in the other.

Summary and Conclusion

The general aim of this study was to identify and measure various perceptual-judgmental response sets in the field of social perception. We are interested in evolving measures of characteristic perceptual tendencies reflected in the sociometric ratings of self and others and in determining the relationships between such tendencies and general adjustment, status within the group, perceptual accuracy and feelings of anxiety and self-regard.

The problem of measuring consistent perceptual tendencies was studied by comparing *predicted* sociometric ratings with *actual* sociometric ratings and by deriving indices of perceived "self" and of perceived "other" acceptance-rejection patterns from such comparisons.

Students in two junior and one senior class at a University High School

were asked to rate each of their classmates on a five-point scale in terms of acceptability as friends, and to predict how each of their classmates would rate them, and be rated by the group on the same basis.

The discrepancies between each of the predictions made and the corresponding actual ratings were used as indices of tendencies within individuals to perceive themselves or others in more or less self-consistent ways. Four such discrepancy scores were derived, indicating a tendency to consistently: (a) under- or overestimate own status (self-direction score), (b) under- or overestimate the status of others (other-direction score), (c) perceive oneself as a highly acceptable or unacceptable person (reciprocity score), and (d) as a highly accepting or unaccepting person (acceptance score). Sociempathic ability was determined by comparing actual sociometric status with the predictions individuals made of same.

High and low groups were constituted from those subjects scoring one sigma above or below the mean respectively on each of the four perceptual set score distributions. These groups were compared with respect to each other and with respect to sociempathic ability, sociometric status, general adjustment, anxiety, level of aspiration and goal tenacity.

1. The reliability of the independent variables was investigated in terms of internal consistency using an odd-even coefficient corrected by the Spearman-Brown formula. The average reliability of these measures, which ranged from .88 to .97, was .94.

2. The correlations between the two direction scores (.12), between the reciprocity and acceptance scores (.04), and between the two sociempathy scores (.06) were approximately zero and indicated that the paired variables involved in each of these correlations are probably unrelated to each other.

3. The tendency to underestimate own status is related to the tendency to have relatively low self-expectations; and, conversely, self-overestimators tend to have high self-expectations. This is indicated by the significant negative correlation between the self-direction scores and the reciprocity scores (— .32).

4. Self-underestimators tend to perceive group members as more generous than themselves in rating others, whereas self-overestimators perceive group members as less generous than themselves in rating others. This is indicated by the significant correlation between the self-direction score and the acceptance score (.36).

5. Significant differences between self-under- and over-estimators were obtained with respect to level of aspiration, and adjustment. These differences indicate that self-underestimators maintain aspiration levels that correspond

more closely to their levels of performance, and tend to adjust their levels of aspiration more realistically to experiences of success and failure. In addition, they have better general adjustment. Self-overestimators, on the other hand, have less realistic aspiration levels which they modify less appropriately in the face of failure.

6. There is a positive relationship between each of the direction scores and their corresponding accuracy scores ($r = .55$ and .37 respectively), indicating that both self- and other-underestimators are more accurate than self- and other-overestimators respectively in predicting their own and others' sociometric status.

7. Other-underestimators perceive the group as less generous than themselves in rating others, whereas other-overestimators perceive the group as more generous than themselves in rating others. This is indicated by the significant negative correlation between the other-direction score and the acceptance score (— .41).

8. There is a significant correlation between the other-direction score and the reciprocity score (.29). Those who anticipate low ratings for themselves tend to overestimate the sociometric status of others, whereas those with high self-expectations underestimate others' status.

9. Significant differences were obtained between the extreme reciprocity groups with respect to general adjustment, estimation of own sociometric status, level of aspiration and goal tenacity scores. These results support finding 3 above, indicating that those whose sociometric expectations from others are low tend to underestimate their own status, whereas those with high expectations tend to overestimate their sociometric status. The latter group of subjects also maintains relatively high aspiration levels which are not readily lowered in the face of continued failure experiences.

The four perceptual response set measures derived in this study are sufficiently stable and have sufficient generality over individuals and over related judgmental tasks to warrant their use for purposes of individual prediction. These measures may be interpreted as generalized personality trends within an individual, i.e., as indices of typical, self-consistent modes of perceiving the interpersonal and hierarchical aspects of social situations.

Self-underestimators perceive themselves as neither very accepting nor as very acceptable persons. They tend to be better adjusted than self-overestimators and to modify their aspirations for future performance more readily and realistically in line with objective experience. They are more accurate in perceiving their own sociometric status, but have less self-regard.

Self-overestimators, on the other hand, perceive themselves as highly

accepting individuals and as on the receiving end of interpersonal relationships. They set and maintain higher aspiration levels than are warranted by their actual performance ability. They are more strongly motivated by strong needs for success and for acceptance by others; yet despite this fact they are less accurate in their perceptions of others.

Whether perceptual judgments tended to be extreme or in the middle range of the distribution was found to be related to motivational orientation. Extreme judgments appeared to be reflective of strong subjectively oriented needs, whereas non-extreme judgments were more typical of subjects who responded more in terms of group norms.

These conclusions are tempered by an awareness of certain unique aspects of our sample, need for replication and use of somewhat gross methods. However, it is felt that valid evidence of individual differences among students was obtained.

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INTERPERSONAL RELATIONS AND GRADATIONS OF STIMULUS STRUCTURE AS FACTORS IN JUDGMENTAL VARIATION: AN EXPERIMENTAL APPROACH*

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INTRODUCTION

This investigation is an attempt to bring together, in one experimental design, two basic aspects of contemporary psychology. In previous investigations these two basic aspects—motivational factors and stimulus structure—have been studied separately.

The aim in the present study is to investigate the effects of variations of a motivational factor (ego-involvement, in this case) upon judgmental activity taking place within conditions of varying degrees of stimulus structure.

A specific issue of the systematic investigation of stimulus structure, *per se,* has only within the last two decades been made by psychologists. Prior to this time there were investigations in which the stimuli employed were of such a nature that they might be considered to have been ambiguous, unstructured, (e.g., 10, 13, 22). Such investigations, however, were concerned with other matters, and made only a passing reference to the nature of the experimental stimulus material itself.

It was not until the middle 30's that a systematic issue was made of the structure of the experimental stimuli as a major determinant of the obtained results. At this time it was specifically pointed out (19), in an experimentally verifiable way, that as the external environment becomes less structured the behavior of an individual does not become correspondingly more random; instead the behavior is more determined by another set of factors—internal factors. As the external factors become less structured the saliency of the internal factors become magnified as points of anchorage in perceptual structuring, and behavior in the total situation results from this structuring.

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* A more complete presentation of this material may be found in the thesis, *Interpersonal Relations and Gradations of Stimulus Structure as Factors in Judgmental Variation: An Experimental Approach*, on file at the University of Oklahoma, Norman, Oklahoma. I wish to thank Dr. Muzafer Sherif for his kindly and generous direction of the thesis. The study was carried out as an experimental unit of a research project, under the direction of Muzafer Sherif, with partial support from an Office of Naval Research contract, to whom acknowledgment is gratefully made.

Many of the more cogent leads which led psychologists and sociologists to this approach have come from conditions arising in actual life situations. In all of the literature pertaining to panics and violent mass movements (which are frequently situations of relatively great ambiguity) there is one point which stands out from all others—uncertainty leads to feelings of unpleasantness and to a search for stabilizing forces. Bartlett (1, p. 20) has termed this "effort after meaning" and Cantril (5, p. 59) has more recently termed the same "desire for meaning." In this striving for relatively stable anchoring points it has been pointed out (20, pp. 81-82) that each individual is extremely receptive to any stimulus which will aid him in his active search for stability. That such is the case is to be found in the ever growing body of literature pertaining to difficult battlefield, transportation and concentration camp situations occurring in World War II (2, 3, 6, 23, 24). In all of such studies the point is repeated that in such ambiguous situations people are extremely susceptible to rumor, which in the majority of instances takes the form of a suggestion from an "authoritative source."

Providing the underlying theoretical background for such field studies is the number of experimental investigations which had as their main objective the investigation of relatively unstructured situations—situational ambiguity —as major contributing factors to behavior (7, 15, 16, 19, 21), and the vast number of studies pertaining to varying intensities of motivational factors as they effect the cognitive processes. These latter studies may roughly be classified into two categories—those dealing with the more "basic" biogenic motives (e.g. 14, 18), and those dealing with the sociogenic motives (e.g. 4, 8, 11, 12, 17).

Special attention should be called to two studies (7, 21) which are most directly pertinent to the present study. In his studies dealing with the effects of suggestion upon behavior Coffin (7) made extensive use of ambiguous situations. In each of his studies he found that the subjects not only accepted suggestions which were presented to them as being from an authoritative source, but they actively incorporated suggestions which were in the same direction as their own prevailing attitudes. In this connection it should be pointed out that the same underlying process is active in this instance as was present in the battlefield and rumor situations spoken of above. In any situation in which several alternative responses are possible any suggestion as to appropriate response will either be accepted or rejected in terms of the individual's existing attitude toward the *total* situation. In the study by Sherif and Harvey (21) it was found that the judgments of autokinetic movement increased in magnitude, in variability, and social influences

became stronger as "situational uncertainty" was progressively increased.

Specifically, the present investigation is concerned with the effects of differing motivational factors (ego-involvement as represented by the strong positive interpersonal relationship existing between two very good friends, and by a minimum of such relationship between strangers) upon judgmental activity taking place within experimental conditions of differing degrees of stimulus structure. Thus, we shall be dealing with two major variables—the experimental conditions and the functional relationship (positive or neutral) between the pairs of individuals—as they interact in the determination of judgmental activity. As will be noted in the description of procedure, the social factor was introduced in the second experimental session through participation of pairs of subjects, each giving his judgments aloud.

On the basis of the above considerations the following hypotheses were formulated:

As the degree of stimulus structure of the experimental condition is progressively decreased.

1. The less the correspondence between stimulus values and judgment values, i.e., the greater the errors of localization.
2. The variability of judgments will increase.
3. The judgments of positively involved partners (friends) will be significantly more influenced by each other's judgments than the judgments of pairs of individuals who are not so involved (neutrals).

Apparatus

The apparatus consisted of a solid plywood circle, six feet in diameter, and twenty stimulus lights (6-8 volt bulbs). The circle was mounted on a stand which held it approximately one foot from the floor. It was divided into twenty equal concentric rings. These were numbered from *1* through *20*, with *1* being the most peripheral and *20* being the most central ring. The stimulus lights which were encased in aluminum tubes, were inserted through holes in the plywood circle. The lights were randomly scattered over the face of the circle.

The light-proof experimental room was the same in all sessions. The room was approximately 20 x 15 feet. The subjects sat approximately 15 feet from the apparatus. At no time were the subjects allowed to see the apparatus.

The material chosen to serve as stimulus points was phosphorescent lucite. Before each experimental session the lucite was exposed to a strong light for a brief period. This material afforded a constant glow for the required time period.

Subjects

Seventy-two subjects took part in the experiment proper. All subjects were students in the University of Oklahoma, and of the total number only two had taken courses in psychology. The subjects were all selected in pairs, the pairing being determined by two general selections criteria: (a) that they be very good friends, (b) that they not know each other.

Those subjects who were selected because of the existing high positive ego-involvement between them were selected according to the following criteria: (a) that they have chosen each other as a roommate at least twice, (b) that the counselor of their dormitory designate them as constant companions in such activities as double dating, choosing each other as partners in various games, asked to be allowed to room together, visiting in each other's home over weekends.

Those subjects who were chosen because of the lack of a functional relationship between them, i.e., strangers, were selected from the various University dormitories. In no instance were two individuals from the same dormitory selected as a pair.

Procedure

All subjects participated in two experimental sessions. The first session each subject served alone, the "a" session. In the second session each served with a predetermined partner. In this session the subjects were divided into two sub-groups, (Gf) and (Gn) groups: the ego-involved partners (friends) being in the (Gf) groups and the "neutral" partners in the (Gn) groups. The two experimental sessions in which a subject participated were identical except for the addition of the partner in the second session.

Two subjects were further sub-divided into experimental categories. One-third of the subjects participated in the A experimental condition (the condition of relatively greatest stimulus structure); one-third participated in the B experimental condition (the condition of relatively intermediate stimulus structure); and one-third participated in the C experimental condition (the condition of relatively least stimulus structure). Thus, the subjects were divided into six sub-categories according to one of the three experimental conditions, and one of the two social situations. The sub-categories were designated as A-Gf, A-Gn; B-Gf, B-Gn; C-Gf, C-Gn.

A diagrammatic sketch of the three experimental conditions is presented in Figure 1.

Condition A: This condition is that of relatively greatest stimulus structure. In Figure 1 it will be noted that the subjects were furnished a

complete circle of lucite during the period in which they were making their estimates.

The subjects were instructed that they would be shown a large ring of light, and within the ring they were to imagine twenty concentric circles. Small flashes of light would appear singly within the ring. Within three

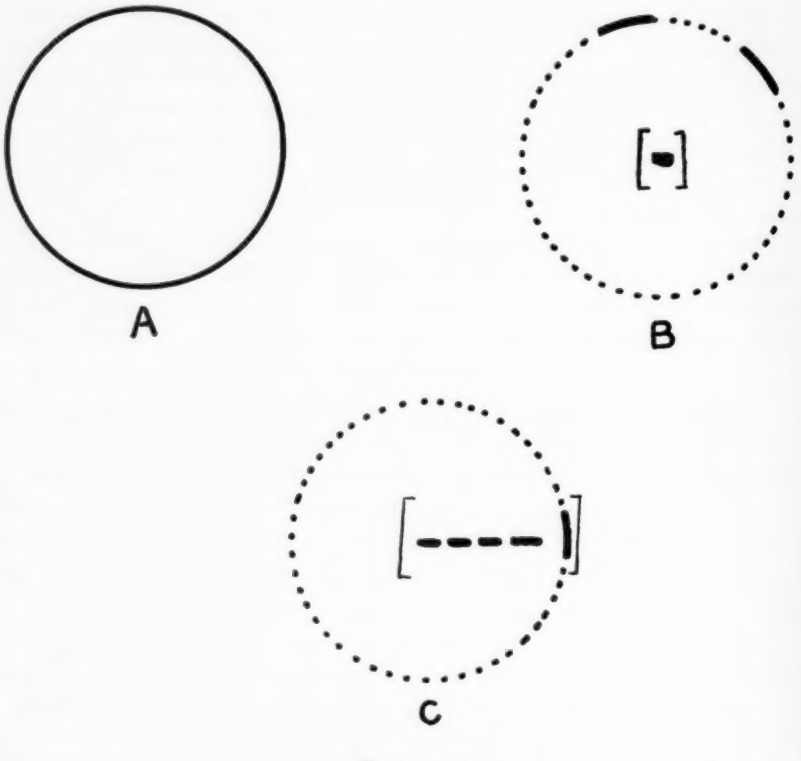

Figure 1

Diagrammatic sketches of the three experimental conditions, showing the lucite visible to the S's while judging the location of the stimulus lights. The solid lines in B and C indicate the relative position of the lucite, the dotted area represents an outline of the plywood circle. In B and C the bracketed areas indicate the position of the lucite shown to the S's prior to actual judging of the stimulus lights.

seconds following the flash they were to report which one of the twenty concentric circles they thought that particular light to be.

Condition B: This condition was of intermediate stimulus structure. In Figure 1 it will be noted that the subjects were shown, prior to actual period of judgment, three points of glowing lucite—two on the circumference and one in the center of the plywood circle. During the period of judgmental activity the center piece of lucite was removed and the subjects were required to make their judgments in terms of the two remaining points of lucite.

The subjects were instructed that they would be shown three points of light, and that they would be able to describe the location and approximate size of the outlined circle from the three "given" points. Sufficient instructions were given until each subject was able to do this.

Condition C: This condition was that of relatively least stimulus structure. It will be noted in Figure 1 that the subjects were shown a series of five points of light prior to the actual judgmental activity. They were instructed that these visible points of light were located on concentric circles 20, 15, 10, 5, and on the circumference of the plywood circle.

They were then required to describe the location and approximate size of the circle, and instructions were given until they were able to do this. They were then given instructions concerning the stimulus flashes, the numbering of the concentric rings, and were told that they were to judge which one of the twenty concentric rings they thought each flash to be in. Following this the entire amount of lucite was removed from the apparatus and the subjects made their judgments in absolute darkness.

It should be pointed out in this connection that no assumption is made concerning the relative distance between the experimental conditions as to compellingness of the stimulus structure.

The experimental condition and the serial order of presentation of the stimulus lights were the same in both the "a" (alone) and the "G" (group) sessions for any one subject. Thus, each subject, in his 100 judgments per session, was exposed to the same series of stimulus lights a total of five times.

Results

During the experimental sessions the subjects verbally reported their judgments as to the location of each of the stimulus lights. These reported judgments were recorded by the experimenter. The difference between each of the 100 judgments and the objective score (as determined by the objective location, i.e., concentric ring in which a particular light actually appeared) was determined and a mean of these 100 absolute errors was

obtained (E score). Following the second session the difference between the two E scores for each individual was obtained (DE score). In addition to these two scores an absolute proportional score (pDE score) for each individual was obtained by dividing the DE score by the E score for the "a" session, multiplied by 100, thus giving a percentage shift for each individual subject.

In order that the results obtained in the two social situations have any meaning it was first necessary that the differences between the judgmental behavior taking place within each of the three experimental conditions be determined. In establishing this difference we were interested in only one set of data—E scores for each subject in the "a" session. To anticipate at least the more obvious criticisms which might be made concerning the use of t in this instance all interpretations of probability have been made at ½ of the available degrees of freedom.

Although this analysis does show that there is a significant difference between the three experimental conditions it does not give a clear picture of the obtained results. A much clearer picture is presented in graphic form in Figure 2. In this Figure it will be noted that the mean for the E scores of condition B does not fall mid-way between A and C, instead it appears that condition B is much more like A. Thus, it must be emphasized that the three experimental conditions are not evenly graduated along the structured-unstructured continuum. It may be inferred, in keeping with the first hypothesis, that as the available stable anchoring points are reduced the error of localization becomes greater and, hence, the less the correspondence between stimulus values and judgment values.

TABLE 1

A Comparison of the E Scores for Each of the Three Experimental Conditions—"a" Session*

Source	df	t	P
A vs B	46	2.525	$<.05$
A vs C	46	15.914	$<.001$
B vs C	46	8.881	$<.001$

In Table II is presented a comparison of the spread of E scores for each of the three experimental conditions. In this it must be remembered

* t evaluated at 11 df. The rationale underlying the interpretation of t in this particular instance is presented by Edwards (9, pp. 201-202).

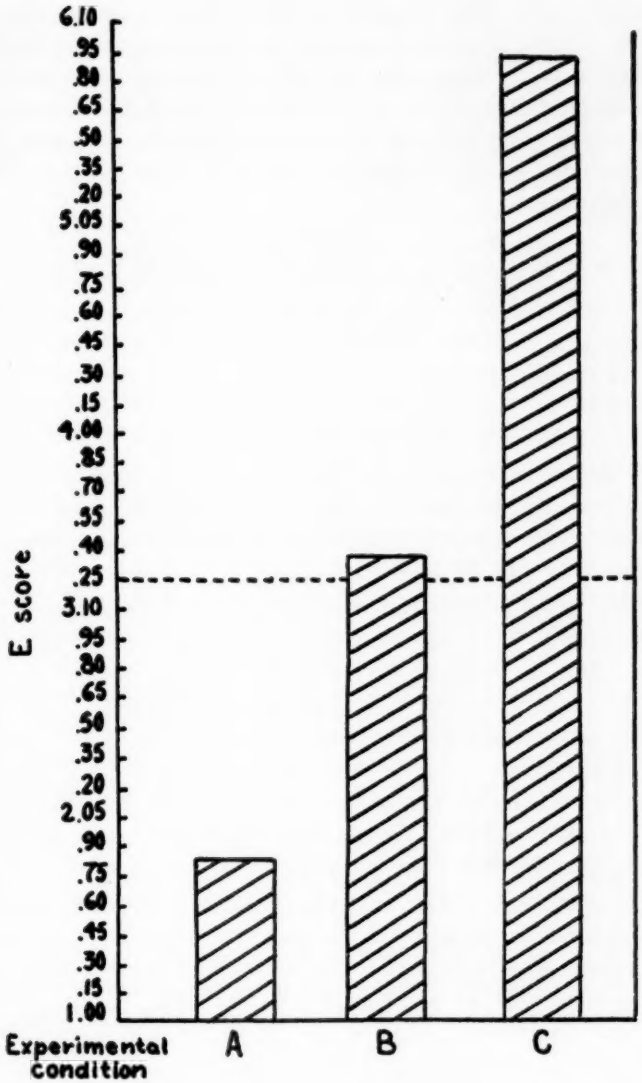

Figure 2

Mean E score according to experimental condition (Dotted line indicates point at which t for A vs B equals .05)

that the judgments given in each of the three conditions were given in response to stimuli the actual location of which remained identical. The only difference in the three experimental conditions was the availability of stable anchoring points. Thus, as is to be seen in this Table, and in keeping with our second hypothesis, as the degree of stimulus structure of experimental conditions is progressively decreased the variability of judgmental behavior increases.

TABLE II

A Comparison of the Spread of E Scores of the Three Experimental Conditions

Source	F	P
A vs B	5.33	$<.01$
A vs C	11.33	$<.01$
B vs C	2.12	$<.05$

In addition to this more formal analysis a valuable insight into the conditions may be obtained from the behavior of the subjects while they were in the process of making judgments, and from the questions and statements made following the sessions.

Briefly, those subjects participating in the A condition appeared to enjoy the session. They seemed to look upon it as a game, and were quite willing to return for another "shot at it." Those subjects who participated in the B condition appeared to become fatigued during the latter phases of the session, as evidenced by much twisting and squirming and quite audible sighing. When these subjects were questioned about this they almost invariably answered with such statements as, "I was disgusted with myself because I couldn't seem to keep in mind where the last light was," or "I was getting mad because I knew I wasn't doing any good."

In contrast to the behavior of the subjects in these two conditions the behavior of those participating in the C condition becomes very meaningful. These subjects invariably had to be prompted to report their judgments within the time limit as given in the instructions. At least some of the tension and frustration under which these subjects were working was expressed in such expletives as "Hell!", and "What the hell was that all about?", or "God, what a mess I made out of that." Such behavior and statements, coupled with the number of subjects (fourteen) who refused for the second session (a total of six subjects found it impossible to return for the second session in both of the other conditions) give great credence to the belief that such a situation is one of discomfort, and tension. In

brief, it would appear that as the availability of anchoring points in the environment is denied there is an arousal of tension, frustration and a subsequent striving on the part of the individual to establish stable points around which perception of the total situation can be structured.

Thus, having determined the difference in judgmental behavior brought about by the experimental conditions it is possible to determine the differences in judgmental activity brought about by the two social situations. To determine the differential effect of the two social situations upon the behavior taking place within the experimental conditions the pDE scores were employed. A *t* analysis of this data is presented in Table III. In this analysis it becomes immediately apparent that the pDE scores of the two social situations do not differ significantly in the relatively most structured experimental condition. But, in the intermediate and the least structured conditions it will be noted that there is a significant differential effect brought about by the social situations. With respect to the comparatively low significance of the difference between the pDE scores in the most structured experimental condition it must be said that such should be expected because of the compellingness of the experimental condition itself. The behavior is held within comparatively narrow limits with very little leeway for individual factors to influence it.

TABLE III

COMPARISON OF THE DIFFERENTIAL EFFECTS OF THE SOCIAL SITUATIONS UPON JUDGMENTAL ACTIVITY TAKING PLACE WITHIN EXPERIMENTAL CONDITIONS*

Source	df	t	p
A-Gf vs A-Gn	22	.666	<.60
B-Gf vs B-Gn	22	48.200	<.01
C-Gf vs C-Gn	22	23.800	<.01

* *t* interpreted at 11 df (9).

Thus, in keeping with the third hypothesis it may be inferred that as the degree of stimulus structure of the experimental condition is progressively decreased the behavior of an individual with whom there is a high degree of positive ego-involvement will bring about a shift in the behavior of the partner which is different from the shift which is brought about by the behavior of an individual with whom there exists no such involvement.

DISCUSSION

We have seen in our findings, as the degree of stimulus structure is progressively decreased the influence of motivational factors (in this case

friendship) becomes more pronounced. This means that it is necessary always to take into account the motives of the individual as well as properties of the stimulus situation faced by the individual. While one may logically posit hypothetical situations in which either motives or stimulus properties are conceived of as the sole determinants of perception and consequent behavior, in actuality such hypothetical postulations are rarely if ever found to be true. All psychological activity and behavior in reality is influenced to some degree by both stimulus and motivational factors. Depending on the degree of structure in the stimulus situations, motivational factors will come in a more weighty way as determinants of perception and reaction. An important implication of this for everyday life is that, when the individual faces unsettled social conditions or critical situations he subjectively provides his own unique anchorages in terms of which he structures the ambiguous situations. If enough people are similarly affected by such critical situations, they get together to do something about it, as a consequence of this interaction new norms and values may evolve which become major anchorages in terms of which the uncertain times are structured.

However, it must be admitted that oftentimes it is very difficult to see the effect of motivational factors in perceptual organization. This is especially true in everyday life where all facets of the "world" fit together into a meaningful whole. But, when the pieces do not fit into a meaningful whole, as in panic situations, it is very evident that people more often than not do behave in terms of their own personal need and value systems and/or they become more susceptible to social influences.

If a developmental concept of ego is accepted rather than the older innate concept it is seen that the ego is developed in terms of the various facets of everyday life. And it would follow if these were either partially or completely removed, by one means or another, the situation demands that reorganization take place in terms of anchorages provided by the unique factors stemming from the individual himself. Such unstructured situations and the ensuing demands on the individual are characterized by frustration, anxiety, and feelings of discomfort, and more important, by a search for stable anchoring points around which behavior may be oriented.

In the present investigation it has been shown that as the possible anchoring points in a situation are progressively eliminated there is a strong tendency for the behavior of a particular individual to become more different from that of all others. And, it was shown that as the stable anchoring points are progressively eliminated the existing positive ego-involvement between two individuals tends to bring about a shift in judgmental activity

which is significantly different from the shift brought about by a minimum of such involvement.

The present investigation is conceived of as being a pilot study in which general trends and tendencies are pointed out. It will be noted that at no time have we been concerned with either over or under estimation, nor have we been concerned with the direction of shift of judgments due to the motivational factor. To have introduced these would have necessitated a much more stringent control of subjects in which the leader-follower relationship and various factors relating to personality structure would have to be investigated. To generalize from these findings to specific instances must be done with much caution.

Summary and Conclusion

This study had as its underlying thesis the investigation of variations of judgmental behavior (employed as a prototype of other "cognitive" processes) in situations of different degrees of stimulus structure and differing ego-involvements (employed as a particular instance of motivational factors). The hypothesis was that there are general, over-all variations of judgmental behavior which correlate with the degree and kind of structure in the total situation.

It was assumed that as the compellingness of the environmental situation decreases greater latitude is allowed for individual factors to influence judgmental activity. This was found to be true when it was shown that as the possible stable anchoring points in the external environment were progressively removed there was a significant increase in the spread of judgments deviating from objective stimulus values.

Within these experimental conditions of differing degrees of structure it was seen that the verbal judgments of another individual, which were seen to serve as possible anchorages, assumed greater importance as the objectively given anchorages were progressively eliminated. And it was seen that the intensity of the functional relationship between two individuals produced significant differential effects upon judgmental variation.

More specifically it was found that at the degree of stimulus structure of the experimental condition was progressively decreased:

1. The less the correspondence between stimulus values and judgmental values (Table I, Figure 2).
2. The variability of judgments increased (Table II).
3. The judgments of positively involved partners (friends) were significantly more influenced by each other's judgments than the judg-

ments of pairs of individuals who were not so positively involved—neutrals (Table III).

This experimental approach to the systematic investigation of different degrees of situational ambiguity and differing motivational factors as they both interact in behavior determination is seen as a more comprehensive approach to the problems of the ever increasing complexity of social behavior.

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A RATIONALE FOR WEIGHTING FIRST, SECOND, AND THIRD SOCIOMETRIC CHOICES

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A perennial problem is the differential weighting of the first, second, and third choices in a sociometric or nominations setup. Good standard procedure is to disregard the order of choice and use the total of all mentions. This procedure will provide a perfect rank correlation with any differential weighting formula if the first, second, and third choices, when analyzed separately, rank the nominees in the same order. With large numbers of judges this will indeed be the case in many situations, or near enough so that differential weighting is meaningless. However, the research person often feels that one first choice is worth considerably more than one third choice and would like to have this difference reflected in the final composite score.

When differential weighting is resorted to, the usual practice is to give a series of unit weights to the three choices. Thus, the first choice might be given three votes, the second two, and the third one. The basic unrecognized problem here is not so much the arbitrary character of the differential weighting among first, second, and third choices, as it is the unnoticed differential between no mention at all and third mention. In such a scheme it is assumed that the jump from no mention at all to third mention is equivalent to the jump from third to second and from second to first. This is an obviously false assumption and arises from interpreting the nominations data in a voting type context. In any situation where differential weighting is to be considered, the differential weighting of no mention versus third mention is the most important weighting problem.

A more consistent rationale can be developed by assuming that what a nominations ballot or sociometric questionnaire asks for is the first few rankings of a potential ranking of all personnel aboard. *The best guess as to the value assigned a nonmentioned person is the average of the unused ranks.* If in addition, the assumption made of a normal distribution of the trait in question, the rationale takes a form which emphasizes the special worth of a first mention. The procedure may be illustrated by a hypothetical case of a sociometric study asking for three choices in a classroom of ten pupils. A first choice may be regarded as indicating that the

person mentioned lies in the area under the normal curve containing the extreme 10% and bounded by $+1.28\sigma$ and infinity. The appropriate weight for a first choice would be a mean value for this area. But since tables providing this are not readily available, a median may be used, with but little distortion if the total number of persons being chosen from is large. The median is the $5\%\sigma$ value, 1.65. The sigma value for a second choice is the median of the area from 1.28 to .88, which is 1.04. The sigma value for the third choice is .67. The sigma value for no choice at all is the median of the remaining 70 per cent of the area, which is —.39. If for computational purposes we give no mention a value of 0, and express the other weights as approximate whole values we get the following: no mention = 0, third choice = 5, second choice = 7, and first choice = 10. For an application in which there are potentially 70 persons who could be mentioned, the sigma values would be 2.45 for first choice, 2.03 for second, 1.80 for third and —.11 for no mention. Approximate whole values for this setting are 12, 10, 9, and 0 respectively, showing increased gap between no mention and third mention, with less interval between third and first. As the potential pool of persons who may be named increases, the similarity between the weighting procedure and the pooling of all mentions disregarding order becomes greater, as far as rank order within the pool is concerned. This procedure of treating the data as ratings rather than as votes should increase the comparability of scores between groups of different sizes. For such purposes, expression of reputational score in terms of an average sigma score value would be indicated.

In view of the general psychometric experience that differential weighting makes little difference, the procedure here outlined is not recommended for general use. For those who persist in preferring some scheme which gives more weight to a first choice than a third, a rational weighting system is here offered.

THE MAPPING OF COMMUNITY ORGANIZATIONS

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The community has been one of the central objects of sociological research for several decades. In the last 20 years interest has focused particularly on the class composition of American communities. Warner and his associates have been leading figures in carrying out this type of analysis.[1] Broadly speaking, these investigations yield a picture of the community in terms of horizontal strata of the population, each stratum made up of those who tend to associate intimately with one another, and the strata ordered in terms of the community prestige of their members.

Valuable as these researches have been in increasing our understanding of the community, the picture of community structure which they give is incomplete. Strata tend to be seen as congeries of individuals. Insufficient analysis is made of the way in which the community breaks up into smaller, well-knit groups and associations. Warner himself has recognized this and, in one of the volumes of the Yankee City series has dealt with the *class composition of organizations*.[2] This lead has been little followed by others, however, and there is particularly wanting any study of the dynamics of community life in terms of the interaction of such groups.

There is convincing evidence that American communities differ from one another sharply in their success in meeting local problems.[3] Although it has been shown that demographic characteristics are important in producing these differences, it is obvious that factors of social organization play a role. It is a plausible hypothesis that the pattern of relations among organizations

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[1] William Lloyd Warner has written the following books on this subject, alone or with collaborators indicated: *The Social Life of a Modern Community* (with Paul S. Lunt), New Haven: Yale University Press, 1941; *The Status System of a Modern Community* (with Paul S. Lunt), New Haven: Yale University Press, 1942; Who Shall be Educated? (with Robert J. Havighurst and Martin B. Loeb), New York: Harper and Bros., 1944; *Democracy in Jonesville,* New York: Harper and Bros., 1949; *Social Class in America* (with Marchia Meeker and Kenneth Eels), Chicago: Science Research Associates, 1949.

[2] *The Status System of a Modern Community,* Chapter I.

[3] Robert C. Angell, *The Moral Integration of American Cities,* 1951 (Part 2 of *American Journal of Sociology,* LVII, No. 2).

will be found to have significance. If energies are being channeled into all sorts of civic, religious, charitable, and recreational groups, it is only common sense to suggest that the degree of conflict or cooperation among them would influence community welfare.

1. The Problem of Mapping Groups

It is against this general background of thought that the methodological work here reported has been undertaken. *The ultimate aim is to study the interactive pattern of groups in the community.* A preliminary step seemed to be to "map" the groups in what might be called the influence-space of the community.[4] It is obvious that a Rotary club whose membership contains many key figures in local life will tend to be cooperative or conflicting only with other organizations high in the influence structure; it will not have relations of equality, and probably not any relations at all, with a fraternal order made up of semi-skilled workmen. This is merely to say that if one had a mapping of the groups in the community as a start, one could proceed more intelligently to examine their interrelationships. The dynamic problems could be more easily located and their nature studied.

As Warner has demonstrated, this mapping can be done if one has already made a status classification of all the adults in the community and then studies the membership lists of all organizations. *One can obtain both an average "height" for each group in the status structure and its "spread"* (the number of classes which it cuts across).[5] But this is an immensely tedious and expensive process. It has been our aim to discover an easier method of accomplishing the same objective.

The method here proposed is to utilize common memberships in organizations to measure both their relative height and relative spread. Two fundamental assumptions about the nature of contemporary American society are

[4] For a somewhat similar mapping but by very laborious methods, see Mhyra S. Minnis, "Cleavage in Women's Organizations", *American Sociological Review* XVIII, Feb. 1953, 47-53. A number of other papers have explored the use of matrix algebra for analyzing sociometric properties of groups. See particularly: Elaine Forsyth and Leo Katz, "A Matrix Approach to the Analysis of Sociometric Data." Sociometry IX (Nov. 1946) 340-7; R. Duncan Luce and Albert D. Perry, "A Method of Matrix Analysis of Group Structure," *Psychometrika* XIV (March 1949) 95-116; and Corlin A. Beum, Jr. and Everett G. Brundage, "A Method for Analyzing the Sociomatrix", Sociometry XIII (May 1950) 141-153. Although the degree of relationship among subgroups can be studied by the methods developed in these papers, none of them deals with the problem of hierarchy.

[5] *The Status System of a Modern Community,* pp. 5-12.

made. If extended empirical research proves either of them ill-founded this method will have no value. The first assumption is that it is possible to stratify the members of organizations in terms of influence in those organizations, at least to the degree of recognizing two strata, such as officers and former officers vs. all other members. It will increase the power of the method if three or more strata can be differentiated, such as officers and former officers, other members of active committees, and other members of the organization (but this is not essential). The second assumption is that any individual tends to take a position in every organization of which he is a member which reflects a general influence position in the community. A successful skilled worker, for instance, will tend to have high rank in a labor union, medium rank to a veterans' organization that cuts all classes, and low rank in a predominantly upper class church of which he is a member. It is highly probable that this second assumption will have more validity in connection with large groups than small ones since the face-to-face familiarity of small groups may make personal characteristics more important than community status in determining position within the group.

It cannot be asserted that current sociological theory makes these two assumptions, but it is certainly true that they are broadly reasonable in the light of such theory. The first assumption is chiefly one of methodological possibility: can we in fact divide organizations into strata that are meaningful in terms of influence? Certainly much evidence from formal groups like bureaucracies and informal groups like the one described in Whyte's *Street Corner Society* indicates that we can. Whether we can rely on such measures as office-holding and committee memberships to reveal such strata is a moot question which will have to be settled by empirical test. The second assumption is more basic. Certainly many sociologists would point out that some very busy people refuse responsibilities and even participate ineffectively in organizations where their community prestige would normally accord them high influence. It seems likely, however, that this is almost exclusively true for a very small number near the top of the prestige pyramid and that it should not affect the mapping of community organizations seriously.

It is of course obvious that community organizations as here used do not include all groups. In particular, families are not appropriate to the sort of analysis here proposed because they do not break down into strata. The same would be true of any highly homogeneous primary group.

One of the values of *the research model* here developed is that it *will afford a crucial test of these assumptions.* If a mapping of community organizations by this method does not check closely with validating investi-

gations by other methods, one or both of the assumptions is wrong. Thus research in these terms should have considerable theoretical importance.

If we make these two assumptions, organizations that have common members can be mapped in relation to one another very easily, provided they are broken into the same number of strata and the proportions of their total memberships in each stratum are the same. Consider groups P and Q in Figure 1, each divided into three equal strata. The lines joining the boxes represent common members of the two organizations. It will be seen that there is a general tendency, though there are exceptions, for these common

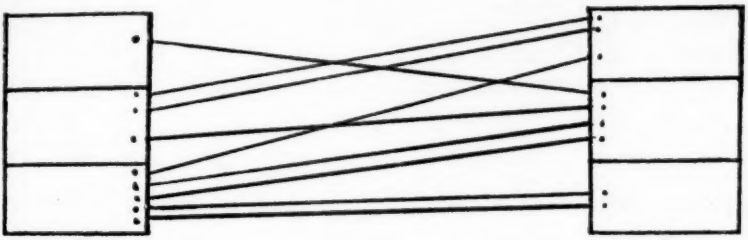

FIGURE 1.

members to have a lower position in organization P than in organization Q. This would indicate that P is higher than Q, for if they were equal our second assumption would require that the connecting lines should tend to the horizontal. It will be noted further that the common members tend to be more nearly at the same level in P than in Q. This indicates that Q has less vertical spread in status than P and should therefore really be represented by a shorter figure.

The difficulty of the matter is that, though one can if necessary stratify two organizations into the same number of strata—at the least two, one cannot make these strata of the same proportionate size. If the executive committee members past and present of one association comprise 15% of the membership, one cannot expect that the same stratum in another association will constitute the same percent. What is needed therefore is a method of dealing with strata that constitute different proportions of their respective organizations. This turns out to be a mathematical problem of considerable interest.

In Sections 2, 3, and 9 of this paper we introduce various measures of height and spread for community organizations. However, the main body of the paper (Sections 4-8) is devoted to the preliminary problem of adjusting for strata of disproportionate sizes. We call this the *bias removal problem*.

We introduce and illustrate two methods of solving this problem. The first of these is simpler but less satisfactory and can be expressed in terms of matrix multiplication. The second method is more precise but is somewhat more complicated. The basic idea involved in both methods is the determination of what portion of one set lies in another set. The only technical tools used that lie beyond elementary algebra are (1) matrix multiplication, (2) set intersection and set union, and (3) maximization (or minimization) over a finite set. We give now a brief explanation of our notation which will cover (2) and (3). If A is a collection or set consisting of elements a_1, a_2, a_3 we write $A = \{a_1,a_2,a_3\}$. More generally we write $A = \{a, \dots\}$ to indicate that A is a set whose typical element is a. The symbol $a \epsilon A$ is read "a belongs to A" or "a is an element of A".

If g(a) is any numerical function of the elements of A we write

$$s = \sum_{a \epsilon A} g(a)$$

and

$$m = \max_{a \epsilon A} g(a)$$

to indicate, respectively, the sum of all values g(a) for a in A and the largest of the numbers g(a) for a in A. Thus if A is a set of n people and g(a) is the height of A then s/n is the average height and m is the greatest height of any member of the set. If $A = \{a, \dots\}$ and $B = \{b, \dots\}$ are any two sets we indicate by $A \bigcap B$ the set consisting of all elements that lie both in A and in B; we call $A \bigcap B$ the *intersection* of A and B. If there are no elements common to the sets A and B we say that $A \bigcap B$ is the *empty set*. We indicate by $A \bigcup B$ the set consisting of all elements that lie in at least one of A or B; we call $A \bigcup B$ the *union* of A and B.

2. The Mathematical Approach to the Problem

Let us examine the simplest possible case. If there were some independent measure of the status or height of individuals in the community one could define height and spread of an organization in the following way. If $P = \{a, \dots\}$ has r members and h(a) is a real number representing the height of a we could take the mean

$$h(P) = \frac{1}{r} \sum_{a \epsilon P} h(a) \tag{1}$$

as a measure of the height of P and for the spread of P we could take the variance

$$(2) \qquad s(P) = \frac{1}{r} \sum_{a \epsilon P} (h(a)\text{-}h(P))^2$$

or the maximum difference

$$(3) \qquad s'(P) = \max_{a \epsilon P} h(a) - \min_{a \epsilon P} h(a) \quad .$$

However, in general, there is no acceptable measure of the status or height of an individual available so it is desirable to construct measures which depend only on the relative number of common members in subdivisions of the various organizations. In this case the measures will only be relative, i.e., they will merely tell which of two organizations is higher without giving a measure of the absolute height of either of the organizations being compared.

3. Relative Height and Spread of Pairs of Organizations

We now lay the groundwork for measures of relative height and relative spread of pairs of stratified organizations. In practice two or three strata will probably be all that can be obtained readily, but since the theory for a general number n of strata presents no essential complications over that for the special cases $n = 2$ and $n = 3$ we treat the general case. Suppose then that each organization P is subdivided into n strata $P_1, \ldots, P_n$ ranging from a highest strata P_1 to a lowest group P_n. We set

$$(4) \qquad p_i = O(P_i) \,/\, O(P) \qquad (i = 1, \ldots, n).$$

[For any group N we denote by O(N) the number of members of N.] Let Q be a second organization with strata $Q_1, \ldots, Q_n$ and set

$$(4') \qquad q_j = O(Q_j) \,/\, O(Q).$$

Now if P and Q have common members, i.e., if $P \bigcap Q$ is not the empty set we let r_{ij} be the proportion of the common members that belong to the i-th strata of P and the j-th strata of Q. Thus we have

$$(5) \qquad r_{ij} = O(P_i \bigcap Q_j)/O(P \bigcap Q) \qquad (i,j = 1, \ldots, n).$$

We wish to construct some function of the p_i, q_j, r_{ij} which will tell which of P and Q is higher, and another function which will tell which has greater spread. It is convenient to present these numbers r_{ij} as the elements of an n-by-n matrix; e.g.

$$(6) \qquad R = \| r_{ij} \| \ .$$

To illustrate these concepts suppose that $n = 3$ and that P has 200

members divided into three strata having, respectively, 70, 50, 80 members. Then $p_1 = .35$, $p_2 = .25$, $p_3 = .40$.

Let Q be a second organization with 300 members and having $q_1 = .30$, $q_2 = .45$, $q_3 = .25$. Next suppose that there are 100 common members (i.e. $O(P \cap Q) = 100$) distributed as follows: $O(P_1 \cap Q_1) = 40$, $O(P_1 \cap Q_2) = 10$, $O(P_2 \cap Q_1) = 5$, $O(P_2 \cap Q_2) = 20$, $O(P_2 \cap Q_3) = 10$, $O(P_3 \cap Q_3) = 15$. Then

$$R = \begin{Vmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{Vmatrix} = \begin{Vmatrix} .40 & .10 & .00 \\ .05 & .20 & .10 \\ .00 & .00 & .15 \end{Vmatrix}.$$

Note that here, as always, the sum of the elements of R is 1.

A special case of importance is that of equal subdivisions, i.e.

$$p_i = q_j = t \qquad (i,j = 1, \ldots, n) \tag{7}$$

where $t = \frac{1}{n}$. In this case the functions will depend only on the n by n matrix by $R = \| r_{ij} \|$.

First consider the problem of relative height. If an individual a belongs to $P_i \cap Q_j$ where $i < j$, i.e., if he occupies a higher position in P than in Q then so far as this individual is concerned Q is higher than P. *This conclusion,* of course, *depends on the assumptions that the individual tries to achieve as high a position as possible in each organization to which he belongs, and that the position achieved by any individual depends only on his "height" in the community* (which we do not know). In practice neither of these assumptions is exactly correct for each individual; each should tend to be correct on the average.

Suppose that we consider two common members b,c of P and Q both in the third strata of Q but with b in P_1 and c in P_2. Both b and c give evidence that Q is higher than P but it seems reasonable to place more weight on b than on c because his relative shift in status in the two organizations is greater. This suggests using the following function as a measure of relative height.

$$f(R) = \sum_{i,j} (i\text{-}j)\ r_{ij} \tag{8}$$

The meaning of this function can be explained as follows: Suppose that 0.1 of all the common members of P and Q are located in P_3 and Q_1. Then the contribution of this particular relation to $\sum_{i,j}$, which is the sum of all such relations, is $(3\text{-}1) \times 0.1$, or 0.2. In general, we can define P as higher than

Q, written $P \underset{h}{>} Q$, if $f(R) > O$. If $f(R) = O$ we say that P and Q have the same height, written $P \underset{h}{=} Q$.

We next obtain another expression for $f(R)$. Let $u_i = \sum_j r_{ij}$ be the sum of the elements in the i-th row of R and let $v_j = \sum_i r_{ij}$ be the sum of the elements in the j-th column of R $(i,j = 1, \ldots, n)$. This means that u_1 is the ratio of the number of common members in P_1 to all common members. Similarly v_1 is the ratio of the number of common members in Q_1 to all common members. Then we have

$$f(R) = \sum_i i(u_i - v_i). \tag{9}$$

To see this we write

$$f(R) = \sum_i \sum_j i\, r_{ij} - \sum_j \sum_i j\, r_{ij} = \sum_i i\, u_i - \sum_j j\, v_j = \sum_i i\,(u_i - v_i).$$

Next, for spread, we first consider for each i the average position in Q of the members of $P_i \bigcap Q$. This is given by

$$r_{i\cdot} = \frac{1}{u_i} \sum_j j\, r_{ij} \qquad (i = 1, \ldots n), \tag{10}$$

and dually

$$r_{\cdot j} = \frac{1}{v_j} \sum_i i\, r_{ij}\,. \tag{11}$$

We then introduce the function

$$g(R) = \sum_{i,j} \left[(r_{i\cdot} - j)^2 \frac{r_{ij}}{u_i} - (r_{\cdot j} - i)^2 \frac{r_{ij}}{v_j}\right] \tag{12}$$

and say that P has greater, equal, or less spread than Q according as $g(R)$ is positive, zero, or negative.

We have described two functions which measure relative height and relative spread in the special case of equal subdivisions. These functions $f(R)$ and $g(R)$ are not the only ones that could be used and are introduced primarily so as to provide something concrete and reasonable to work with in building a theory. We already have indicated why we need measures of height and spread. In Section 9 we consider several ways of using these functions to define other measures.

Now, we observe that if $P \bigcap Q$ is empty (e.g., P = Rotary, Q = Lions or P = Methodists, Q = Catholics) we get no comparison. One might say

if $P \cap Q$ is empty but $P \cap S$ and $Q \cap S$ are not empty we should somehow use the functions f and g computed first for P and S and then for Q and S and then make some comparison of P and Q. Such a comparison would be justified only if the order given by the function f is transitive, i.e., $P <_h Q$ and $Q <_h S$ implies $P <_h S$. This is not necessarily the case, as the following example shows. Take $n = 2$ and let the only common members be those indicated in the table below.

P		Q		S	
P_1	a_1	Q_1	a_2	S_1	a_3
P_2	a_3	Q_2	a_1	S_2	a_2

then clearly $P <_h Q$, $Q <_h S$, and $S <_h P$.

If it were true that each individual had a height in the community which determined his *exact* position in every organization of which he was a member, then examples such as this one could not occur and the ordering would be transitive. However, we are only assuming a *tendency* for correlation between community status and organization status of each individual. Methods for obtaining transitivity are discussed in Section 9 below.

4. Unbalanced Stratification

We turn next to the case where the stratification is not necessarily into subdivisions of equal size. Let P and Q be two organizations for which the numbers p_i, q_j defined by Formulas (4) and (4′) are not assumed to be all equal to $t(= 1/n)$. We consider how the numbers p_i, q_j should be introduced into our measures of height and spread. The point of view we take is that *these numbers should be used in correcting the matrix R (Formula (6)) for any bias introduced by the unequal subdivisions.* We do this by constructing a new matrix $R^* = (r^*_{ij})$ whose entries are estimates, based on the observed r_{ij}, p_i, q_j, of what the matrix R would have been had the subdivisions been equal. We shall describe the process of passing from R to R* as removing the *bias* caused by use of unbalanced stratification.

We will present two methods of determining a new matrix R* from R. Since there is no priori test which we can use to tell whether R* is a valid replacement for R we next set up some general criteria which will serve as tests for the adequacy of a bias removing construction.

First, we have some requirements for whatever functions are used to measure height and spread. If the subdivisions of P and Q are equal and the

matrix R is symmetric (i.e., $r_{ij} = r_{ji}$) we require that P and Q shall have the same height and the same spread.

Consider the case of a single organization P stratified by two different investigators into subsets $P_1, \ldots, P_n$ and $Q_1, \ldots, Q_n$ with corresponding proportions $p_1, \ldots, p_n$ and $q_1, \ldots, q_n$. We now apply any measures of height and spread treating P as though it were two organizations. *We assume that the two stratifications are consistent in the sense that there exists a simple ordering of the individuals which is a refinement of both stratifications.* This is equivalent to the requirement that for each i and j one of the two sets $P_1 \cup \ldots \cup P_i$, $Q_1 \cup \ldots \cup Q_j$ contains the other. This consistency is equivalent to requiring that the relative standings of no pair of members of P shall be reversed in the two stratifications, e.g., if b is a member of P_1 and c is a member of P_2 then we cannot have c a member of Q_1 and b a member of Q_2. However, we could have both b and c members either of Q_1 or of Q_2 without inconsistency.

This assumption of consistency makes it possible to compute the matrix R by computing its elements r_{ij} as functions of the p_i and q_j. First we note that when P = Q the denominator in (5) can be simplified to just O(P). Now by our consistency hypothesis one of P_1, Q_1 contains the other and so for i = j = 1 the numerator of (5) is either $O(P_1)$ or $O(Q_1)$ according as q_1 or p_1 is larger. Hence $r_{11} = \min(p_1, q_1)$.

Next if $r_{11} = p_1$, then since all of P_1 is contained in Q_1 the intersection $P_1 \cap Q_2$ will be empty and hence $r_{12} = 0$. However, if $r_{11} = q_1$ then $r_{11} + r_{12}$ will be $q_1 + q_2$ if Q_2 is contained in P_1 and $r_{11} + r_{12}$ will be p_1 if Q_2 is not contained in P_1. Hence

$$r_{11} + r_{12} = \min(p_1, q_1 + q_2).$$

Proceeding inductively and taking account of all possibilities for overlapping of the subdivisions P_i and Q_j we get

$$r_{11} + r_{12} + \ldots + r_{1j} = \min \left(p_1, \max\left(0, q_1 + \ldots + q_j - p_1 - \ldots - p_{i-1}\right)\right) \tag{13}$$

and its symmetric counterpart

$$r_{1j} + r_{2j} + \ldots + r_{ij} = \min \left(q_j, \max\left(0, p_1 + \ldots + p_i - q_1 - \ldots - q_{j-1}\right)\right). \tag{14}$$

In particular, for the row and column sums u_i and v_j we get

$$u_i = p_i, \; v_j = q_j \quad (i, j = 1, \ldots, n). \tag{15}$$

Now suppose that a function $R^* = b(R, p_1, \ldots, p_n, q_1, \ldots, q_n)$ is pro-

posed as a bias removing construction. Complete removal of bias for two consistent stratifications of a single organization P would lead to

$$R^* = t\, I_n, \tag{16}$$

since this is what would be obtained from consistent equal subdivisions. [Here $I_n = \| \delta_{ij} \|$ is the n-rowed identity matrix.] However, if this were not achieved one might ask that R^* be symmetric, i.e.,

$$R^* = (R^*)^{Tr}, \tag{17}$$

here Tr indicates transposed matrix; i.e., the matrix whose rows are the columns of R^*. If R^* is symmetric then we at least are assured that we will not be claiming that an organization is higher than (or has more spread than) itself.

Finally with reference to particular measures $f(R)$ and $g(R)$ of relative height and of relative spread the least we could ask for would be a process of bias removal for which

$$f(R^*) = O \text{ and } g(R^*) = O. \tag{18}$$

Note that (16) guarantees (17) and (18), and (17) guarantees (18), whereas knowing that (18) is true for one pair of functions f and g gives no guarantee that the same will hold for other measures. Thus it is highly desirable to achieve (16) or (17).

5. Bias Removal by Matrix Multiplication

If P and Q are two stratified organizations the bias in their comparison matrix R can be regarded as coming from unbalance in both stratifications. It is natural to ask if we can remove the bias in two steps, one to care for the unbalance in the P_i and one for the unbalance in the Q_j; and moreover, so that the first step is independent of Q and the second step is independent of P. In other words, given a stratification of an organization P can we find a correction operation which accounts for the part of the bias caused by this stratification?

Let $P_1, \ldots, P_n$ be a stratification of P and let $T_1, \ldots, T_n$ be a consistent equal stratification. [Here we assume either that $O(P)$ is divisible by n or that $O(P)$ is large enough in comparison with n so that approximately equal subdivisions are possible. For example, the case $O(P) = 10$ and $n = 6$ would be ruled out, but $O(P) = 50$ and $n = 3$ would be accepted. Actually the corrections obtained can be applied in every case but the justification depends on the existence of the T_i.]

Now suppose that m_{ij} is the proportion of P_j which lies in T_i, i.e.,

$m_{ij} = O(P_j \cap T_i)/O(P_j)$. Clearly $P_j = (P_j \cap T_1) \cup \cdots \cup (P_j \cap T_n)$, hence

$$\sum_i m_{ij} = 1. \tag{19}$$

Since $p_j = O(P_j) / O(P)$ and $t = O(T_i) / O(P)$ we have from $T_i = O(P_1 \cap T_i) \cup \cdots \cup (P_n \cap T_i)$ that

$$\frac{O(T_i)}{O(P)} = \frac{1}{(O(P)} \sum_j (O(P_j \cap T_i) = \sum_j \frac{O(P_j \cap T_i)}{(O(P_j)} \cdot \frac{O(P_j)}{O(P)}$$

or

$$t = \sum_j m_{ij} p_j \,. \tag{20}$$

Because of our assumption of consistency between the P_j and T_i stratifications we get

(21)

$$m_{ij}\, p_j = \begin{cases} 0 & \text{if } p_1 + \cdots + p_j \leqslant (i\text{-}1)t \\ p_1 + \cdots + p_j\text{-}(i\text{-}1)t & \text{if } p_1 + \cdots + p_{j-1} \leqslant (i\text{-}1)t < p_1 + \cdots + p_j \leqslant it \\ t & \text{if } p_1 + \cdots + p_{j-1} \leqslant (i\text{-}1)t \text{ and } it \leqslant p_1 + \cdots + p_j \\ p_j & \text{if } (i\text{-}1)\ t \leqslant p_1 + \cdots + p_{j-1} \text{ and } p_1 + \cdots + p_j < it \\ it - (p_1 + \cdots + p_{j-1}) & \text{if } (i\text{-}1)t \leqslant p_1 + \cdots + p_{j-1} \leqslant t \leqslant p_1 + \cdots + p_j \\ 0 & \text{if } it \leqslant p_1 + \cdots + p_{j-1} \end{cases}$$

In interpreting Formula (21) for $j = 1$ we replace each sum $p_1 + \cdots + p_{j-1}$ by O.

We define the bias correction for P to be the replacement of the matrix R by the matrix R′ where

$$r'_{ij} = \sum_\nu m_{j\nu} r_{\nu j} \tag{22}$$

This has the effect of splitting $r_{\nu j}$ into the same proportions as P_ν is split by the T_j.

In matrix form (22) becomes

$$R' = MR \tag{23}$$

where $M = \| m_{ij} \|$

We give an example illustrating a geometric device which may facilitate computation of the m_{ij}. Suppose that $n = 3$, $p_1 = \frac{1}{2}$ $p_2 = \frac{1}{3}$ $p_3 = \frac{1}{6}$. Then we indicate the regions P_i, T_i and their sizes in the following diagram.

P_1	$\frac{1}{2}$	P_2	$\frac{1}{3}$	P_3	$\frac{1}{6}$
T_1	$\frac{1}{3}$	T_2	$\frac{1}{3}$	T_3	$\frac{1}{3}$

Now it is clear that $\frac{2}{3}$ of P_1 lies in T_1 and that the remaining of $\frac{1}{3}$ of P_1 lies in T_2. Thus $m_{11} = \frac{2}{3}$, $m_{21} = \frac{1}{3}$, $m_{31} = 0$; proceeding in this manner we get

$$M = \begin{Vmatrix} \frac{2}{3} & 0 & 0 \\ \frac{1}{3} & \frac{1}{2} & 0 \\ 0 & \frac{1}{2} & 1 \end{Vmatrix}$$

Formula (21) can be derived by use of a diagram of this type.

To remove the bias caused by inequalities in the stratification of Q we form the matrix $N = (n_{ij})$ where $n_{ij} = O(Q_j \cap J_i) \,/\, O(Q_j)$ and then replace R′ by R* where

$$r^*_{ij} = \sum_{\nu} r'_{i\nu}\, n_{j\nu}\,. \tag{24}$$

In matrix form

$$R^* = R'N^{Tr} = MRN^{Tr}\,. \tag{25}$$

The associativity of matrix multiplication, i.e., $(MR)N^{Tr} = M(RN^{Tr})$, shows that the final result is independent of the order of the corrections.

The following example illustrates the procedure. Let P = Q have two consistent stratifications in which $p_1 = \frac{1}{2}$, $p_2 = \frac{1}{3}$, $p_3 = \frac{1}{6}$, and $q_1 = \frac{1}{6}$, $q_2 = \frac{1}{2}$, $q_3 = \frac{1}{3}$, then (see (13) and (21) for computations of R, M, and N)

(26)

$$R = \begin{Vmatrix} \frac{1}{6} & \frac{1}{3} & 0 \\ 0 & \frac{1}{6} & \frac{1}{6} \\ 0 & 0 & \frac{1}{6} \end{Vmatrix}, \quad M = \begin{Vmatrix} \frac{2}{3} & 0 & 0 \\ \frac{1}{3} & \frac{1}{2} & 0 \\ 0 & \frac{1}{2} & 1 \end{Vmatrix} = N' \begin{Vmatrix} 1 & \frac{1}{3} & 0 \\ 0 & \frac{2}{3} & 0 \\ 0 & 0 & 1 \end{Vmatrix}$$

and

(27)

$$R^* = MRN^{Tr} = \begin{Vmatrix} \frac{5}{27} & \frac{4}{27} & 0 \\ \frac{13}{108} & \frac{7}{54} & \frac{1}{12} \\ \frac{1}{36} & \frac{1}{18} & \frac{1}{4} \end{Vmatrix}$$

Note that each row and column in R^* has sum $\frac{1}{3}$ and hence by (9) $f(R^*) = O$. This means that in this special case this method of removing bias satisfies condition (18) for the relative height function f.

This result is no accident. For let P_i and Q_i be any two consistent stratifications of an organization into n subdivisions, and let $R^* = MRN^{Tr}$. The $u^*_i = v^*_j = t$ where $u^*_i = \sum_\nu r^*_{i\nu}$, etc. To see this we note that

$$u^*_i = \sum_\nu r^*_{i\nu} = \sum_{\nu,\mu,\lambda} m_{i\mu}\, r_{\mu\lambda}\, n_{\nu\lambda}. \tag{28}$$

Now by (19), $\sum_\nu n_{\nu\lambda} = 1$, hence $u^*_i = \sum_{\mu,\lambda} m_{i\mu}\, r_{\mu\lambda}$. By (15) $\sum_\lambda r_{\mu\lambda} = p_\mu$, hence $u^*_i = \sum_\mu m_{i\mu}\, p_\mu$ and by (20) this is t. The proof for $v^*_j = t$ is similar.

It now follows that from (9) that $f(R^*) = O$, i.e., condition (18) holds for the function f defined in (8). However, for R^* given by (27) we do not have $g(R^*) = O$ hence the second half of (18) fails for the function g given by (12). Of course (27) shows that neither (17) nor (16) hold for this type of bias correction.

6. Bias Removal by Simultaneous Corrections.

Although this first method is not entirely satisfactory it points the way to a second more refined method of correction which satisfies our strongest criterion (cf. formula 16)). In the example above $p_1 = \frac{1}{2}$ was too large and $q_1 = \frac{1}{6}$ was too small and we corrected each r_{ij} to take account of this. Now since Q_1 is part of T_1 perhaps we should have assumed that all members of $P_1 \bigcap Q_1$ belonged to T_1 and hence assigned all of r_{11} to r^*_{11}, as well as also assigning to r^*_{11} a portion of r_{12} to account for the part of Q_2 that is in T_1; the remaining portion of r_{12} would then be assigned to r^*_{22} since it corresponds to the parts of P_1 and Q_2 which lie in T_2.

The method of bias removal by simultaneous corrections, which we now introduce, incorporates and formalizes this idea.

Suppose that $P_1 \bigcup \ldots \bigcup P_{h-1}$ is a proper subset of $T_1 \bigcup \ldots \bigcup T_i$ which is in turn a subset of $P_1 \bigcup \ldots \bigcup P_h$, i.e., $p_1 + \ldots + p_{h-1} < it \leqslant p_1 + ,,, + p_h$. It seems reasonable to require that

It seems reasonable to require that

$$u^*_1 + \ldots + u^*_i = u_1 + \ldots + u_{h-1} + \alpha u_h \tag{29}$$

where $\alpha = (it - (p_1 + \ldots + p_{h-1})) / p_h$. This is equivalent to assuming that for each organization Q we have

$$\frac{O((T_1 \bigcup \ldots \bigcup T_i) \bigcap P_h \bigcap Q)}{O(P_h \bigcap Q)} = \frac{O((T_i \bigcup \ldots \bigcup T_i) \bigcap P_h)}{O(P_h)} \tag{30}$$

We can interpret u_i as the number of members of P_1 that are in Q divided by the number of members of P that are in Q. Formula (30) represents an interorganization consistency hypothesis and Formula (29) is an estimate, based on a strict proportionality adjustment, for what portion of the total intersection of P and Q should be assigned to hypothetical i-th strata T_i of P.

We introduce a more detailed notation to care for all i. Let h_i be defined by the equation

$$p_1 + \ldots + p_{h_i-1} < it \leqslant p_1 + \ldots + p_{h_i} \quad (i = 1, \ldots, n) \tag{31}$$

and let

$$\alpha_i = (it - p_1 - \ldots - p_{h_i-1}) / p_{h_i} \quad (i = 1, \ldots, n). \tag{32}$$

Similarly suppose that k_j and β_j are defined by

(33) $q_1 + \ldots + q_{k_j-1} < jt \leqslant q_1 + \ldots + q_{h_j}$ $(j = 1, \ldots, n)$

and

(34) $\beta_j = (jt - q_1 - \ldots - q_{h_j-1}) / q_{k_j}$ $(j = 1, \ldots, n)$.

We now define u^*_i and v^*_j inductively by the equations

(35) $u^*_i = u_1 + \ldots + u_{h_j-1} + \alpha_i u_{h_i} - u^*_1 - \ldots - u^*_{i-1}$ $(i = 1, \ldots, n)$

and

(36) $v^*_j = v_1 + \ldots + v_{k_j-1} + \beta_j v_{h_j} - v^*_1 - \ldots - v^*_{j-1}$ $(j = 1, \ldots, n)$.

Formulas (35) and (36) provide adjustments for the intersections of each strata of one organization with the entire other organization. In order to adjust for the intersections of strata with strata we must next define a matrix $R = \| r^*_{ij} \|$ for which the u^*_i and v^*_j are respectively the row and column sums. Our definitions are inductive; to determine r^*_{ij} we assume that all r^*_{hj}, r^*_{ik}, with $h < i$ or $k < j$ are already known, i.e., we proceed one step at a time starting in the upper left hand corner of R^* and advancing down or to the right until we finally reach the lower right hand corner. In Formula (41) below the terms c_{ij}*, d_{ij}* are included so as to make certain that the row or column sums shall not exceed the specified amounts u^*_i or v^*_j, respectively. The other terms provide that the correct proportion of u_{h_i} or v_{k_j} shall be assigned to r_{ij}*.

First, we set

(37) $c_{ij} = u_{h_i} - r_{h_i 1} - \ldots - r_{h_i k_j}$ $(i, j = 1, \ldots, n)$

(38) $d_{ij} = v_{k_j} - r_{1 k_j} - \ldots - r_{h_i k_j}$ $(i, j = 1, \ldots, n)$

(39) $c^*_{ij} = u^*_i - r^*_{i1} - \ldots - r^*_{ij-1}$ $(i, j = 1, \ldots, n)$

(40) $d^*_{ij} = v^*_j - r^*_{ij} - \ldots - r^*_{i-1j}$ $(i, j = 1, \ldots, n)$

and then

(41) $r^*_{ij} = \min \{c^*_{ij}, d^*_{ij}, \max (c^*_{ij} - \alpha_i c_{ij}, d^*_{ij} - \beta_j d_{ij}) \}$.

Note, that for $i = j = 1$ (41) reduces to

(42) $r^*_{11} = \min \{u^*_1, v^*_1, \max (u^*_1 - \alpha_1 c_{11}, v^*_1 - \beta_1 d_{11}) \}$.

which gives a basis for the inductive definition.

We now apply this second method of correction to the test case of two consistent subdivisions of an organization P. We now have from (15) $u_i = p_i$, $v_j = q_j$ and hence from (32) and (34) we get

(43) $u^*_i = v^*_j = t$ $(i, j = 1 \ldots, n)$.

Next from (13) and (14) we get

$c_{ij} = p_{h_i} - \min\,(p_{h_j}, q_1 + \ldots + q_{k_j} - p_1 - \ldots - p_{h_i-1})$

and

$d_{ij} = q_{k_j} - \min\,(q_{k_j}, p_1 + \ldots + p_{h_i} - q_1 - \ldots - q_{k_j-1})$.

Thus $c_{ij} = 0$ if $p_1 + \ldots + p_{h_i} \leqslant q_1 + \ldots + q_{k_j}$ and otherwise $d_{ij} = 0$; hence max $(c^*_{ij} - a_i\, c_{ij}, d^*_{ij} - \beta_j\, d_{ij}) > \min\,(c^*_{ij}, d^*_{ij})$ from which it follows that

$$r^*_{ij} = \min\,(c^*_{ij}, d^*_{ij}) \quad (i, j = 1, \ldots, n). \tag{44}$$

In particular $r_{11} = t$. We now take as an induction hypothesis that

$$r^*_{\nu\mu} = t\delta_{\mu\nu} \tag{45}$$

for all $(\nu, \mu) \neq (i, j)$ such that $\nu \leqslant i$, $\mu \leqslant j$. Then

$$c_{ij} = t - \sum_{\mu=1}^{j-1} t\delta_{i\mu} = \begin{cases} t \text{ if } j \leqslant i \\ 0 \text{ if } j > i \end{cases} \tag{46}$$

and

$$d^*_{ij} = \begin{cases} t \text{ if } i \leqslant j \\ 0 \text{ if } i > j. \end{cases} \tag{47}$$

Hence

$$r^*_{ij} = \min\,(c^*_{ij}, d^*_{ij}) = t\delta_{ij}\,.$$

This completes the induction argument and establishes the equality $R^* = tI_n$. *Thus we see that this second method of removing bias meets our strongest test condition* (16), whereas the first method gives only the weaker condition (18) and this only for the f(R) given by (9).

7. A Relation between the Two Methods of Removing Bias.

Although our two methods for removing bias seem quite different, there is one important common property, namely, they lead to exactly the same conclusions concerning the relative height of any two organizations. We now prove this statement. In section 8 we shall see that the same is not true for relative spread.

Let R^*_1 be the comparison matrix after bias is removed by matrix multiplication. Let R^*_2 be the comparison matrix after bias is removed by simultaneous corrections. Let u^{-*}_i and v^{-*}_j denote the row and column sums respectively for R^*_2 (u^*_i and v^*_j will refer to R^*_1).

First we will show that

$$u^*_i = u^{-*}_i\,. \tag{48}$$

To prove this it is convenient to have (21) written in a different form. After dividing both members of (21) by p_j and introducing the h_i defined in (31) we get

$$(49) \qquad m_{ij} = \begin{cases} 0 & \text{if } j < h_{i-1} \\ i - a_{i-1} & \text{if } j = h_{i-1} < h_i \\ t/p_j & \text{if } h_{i-1} = j = h_i \\ 1 & \text{if } h_{i-1} < j < h_i \\ a_i & \text{if } h_{i-1} < j = h_i \\ 0 & \text{if } h_i < j \end{cases}$$

where $$a_i = \frac{it - p_1 - \ldots - p_{h_i-1}}{p_{h_i 1}},$$

and

$$1 - a_{i-1} = \frac{(i-1)t - p_1 - \ldots - p_{h_{i-1}-1}}{p_{1h_{i-1}}} = \frac{p_1 + \ldots + p_{h_{i-1}} - (i-1)t}{p_{h_{i-1}}}.$$

Remembering that $R^*_1 = MRN^{Tr}$, and using (28) and (19), we write

We now give four examples which serve two roles. First, they illustrate the two bias-removing processes in concrete numerical form, and second, they illustrate the need for bias-removal. Each of these examples is concluded with a statement showing just what point or points it illustrates. These conclusions are summarized at the end of the section.

$$(50) \qquad \overset{*}{u}_i = \sum_{\nu,\mu,\lambda} m_{i\nu}\, r_{\nu\mu}\, n_{\lambda\mu} = \sum_{\nu,\mu} m_{j\nu}\, r_{\nu\mu} = \sum_{\nu} m_{i\nu}\, u_\nu .$$

We have from (35), using the new notation,

$$(51) \qquad \bar{u}^*_i = u_1 + \ldots + u_{h_i-1} + a_i\, u_{h_i} - (\bar{u}^*_1 + \ldots + \bar{u}^*_{i-2} + \bar{u}^*_{i-1})$$

and

$$(52) \qquad \bar{u}^*_{i-1} = u_1 + \ldots + u_{h_{i-1}-1} + a_{i-1} u_{h_{i-1}} - (\bar{u}^*_1 + \ldots + \bar{u}^*_{i-2}).$$

Hence, on substituting (52) in (51), we write

$$(53) \qquad u_i = (1 - a_{i-1})\, u_{h_{i-1}} + u_{h_{i-1}+1} + \ldots + u_{h_i-1} + a_i u_{h_i}, \text{ if } h_{i-1} < h_i .$$

If $h_{i-1} = \bar{h}^*_i$, then

$$(54) \qquad \bar{u}^*_i = (a_i - a_{i-1})\, u_{h_i} = \frac{t}{p_{h_i}} \cdot u_{h_i} = m_{ih_i} u_{h_i} ,$$

since

$$a_i - a_{i-1} = \frac{it - (p_1 + \ldots + p_{h_i-1})}{p_{h_i}} - \frac{(i-1)t - (p_1 + \ldots + p_{h_i-1})}{p_{h_i}}$$

$$= \frac{t}{p_{h_i}}$$

So in any case, we see by (49) that

$$\bar{u}_i^* = \sum_j m_{ij} u_j \tag{55}$$

for if $j < h_{i-1}$ or $j > h_i$ then $m_{ij} = 0$. Thus $u_i^* = \bar{u}_i^*$. By a similar argument

$$v_j^* = \bar{v}_j^* \tag{56}$$

Next from (9), (48) and (56) it follows that

$$f(R_1^*) = \sum_i i(u_i^* - v_i^*) = \sum_i i(\bar{u}_i^* - \bar{v}_i^*) = f(R_2^*) . \tag{57}$$

Thus *for computing relative height the first correction gives the same result as the second.*

8. Some Illustrative Examples†

The particular cases of equal consistent and unbalanced consistent stratifications have been covered in the development of the theory. We will now illustrate the theory for unbalanced stratifications when a comparison matrix R is given.

Example 1. Let P and Q be two organizations with two stratifications each where $p_1 = \frac{2}{5}$, $p_2 = \frac{3}{5}$, $q_1 = \frac{4}{7}$, $q_2 = \frac{3}{7}$ and

$$R = \begin{Vmatrix} \frac{2}{10} & \frac{4}{10} \\ \frac{3}{10} & \frac{1}{10} \end{Vmatrix} = \frac{1}{10} \begin{Vmatrix} 2 & 4 \\ 3 & 1 \end{Vmatrix} .$$

For example, P may have 50 members with 20 belonging to P_1 and 30 to P_2, and Q may contain 70 members with 40 belonging to Q_1 and 30 belonging to Q_2. Of the 10 members P and Q have in common 2 of the members in P_1 are also in Q_1, 4 of the members in P_1 are in Q_2, 3 members in P_2 are in Q_1, and 1 member in P_1 is in Q_2.

† These examples were worked out by Mr. R. L. Wine.

Now $u_1 = \frac{6}{10}$, $u_2 = \frac{4}{10}$, $v_1 = \frac{5}{10}$ and $v_2 = \frac{5}{10}$. So from (9),

$$f(R) = 1(\frac{6}{10} - \frac{5}{10}) + 2(\frac{4}{10} - \frac{5}{10}) = -\frac{1}{10}.$$

Thus we conclude that Q is higher than P for the biased matrix R.

Further, $r_{1.} = \frac{5}{3}$, $r_{2.} = \frac{5}{4}$, $r_{.1} = \frac{8}{5}$ and $r_{.2} = \frac{6}{5}$. Thus by (12)

$$g(R) = (\frac{5}{3} - 1)^2 \frac{2}{6} + (\frac{5}{3} - 2)^2 \frac{4}{6} + (\frac{5}{4} - 1)^2) \frac{3}{4} + (\frac{5}{4} - 2)^2 \frac{1}{4}$$

$$- (\frac{8}{5} - 1)^2 \frac{2}{5} - (\frac{8}{5} - 2)^2 \frac{3}{5} - (\frac{6}{5} - 1)^2 \frac{4}{5} - (\frac{6}{5} - 2)^2 \frac{1}{5} = \frac{7}{720}.$$

So we find P has greater spread than Q.

We wish also to find the unbiased matrix R^*_1. From the definitions of m_{ij} and n_{ij}, using the particular illustration with 50 and 70 members respectively, we find that

$$M = \begin{Vmatrix} 1 & \frac{1}{6} \\ 0 & \frac{5}{6} \end{Vmatrix} \quad \text{and} \quad N = \begin{Vmatrix} \frac{7}{8} & 0 \\ \frac{1}{8} & 0 \end{Vmatrix}.$$

[In general, M and N may also be found by (21).] So

$$R_1^* = (MR)N^{Tr} = \frac{1}{60} \begin{Vmatrix} 15 & 25 \\ 15 & 5 \end{Vmatrix} \cdot \begin{Vmatrix} \frac{7}{8} & \frac{1}{8} \\ 0 & 1 \end{Vmatrix} = \frac{1}{96} \begin{Vmatrix} 21 & 43 \\ 21 & 11 \end{Vmatrix}.$$

Hence by (9) and (12),

$$f(R_1^*) = \frac{11}{48} \sim -.229$$

and

$$g(R_1^*) \sim .034, \text{ where } \sim \text{ is an approximation symbol.}$$

Finally, R_2^* is found in the following way. Since $t = \frac{1}{2}$, for $i = 1$

$\frac{2}{5} < 1 \cdot \frac{1}{2} \leqslant \frac{2}{5} + \frac{3}{5}$ and thus $h_1 = 2$. So by (32) $a_1 = \dfrac{\frac{1}{2} - \frac{2}{5}}{\frac{3}{5}} = \frac{1}{6}$.

Similarly when $i = 2$, $h_2 = 2$ and $a_2 = 1$, when $j = 1$, $k_1 = 1$ and $\beta_1 = \frac{7}{8}$ and when $j = 2$, $k_2 = 2$ and $\beta_2 = 1$. Thus by (35) and (36), $\overset{*}{u}_1 = u_1 + a_1 u_2 = \frac{2}{3}$ $\overset{*}{u}_2 = \frac{1}{3}$, $\overset{*}{v}_1 = \frac{7}{16}$ and $\overset{*}{v}_2 = \frac{9}{16}$. Further using (37) and (38), $c_{11} = u_2 = r_{21} = \frac{1}{10}$, $c_{12} = O$, $c_{21} = \frac{1}{10}$ $c_{22} = O$, $d_{11} = O$ $d_{12} = d_{21} = d_{22}$. From (39), (40), and (41) we get in order

$$\overset{*}{c}_{11} = \overset{*}{u}_1 = \frac{3}{3},$$

$$\overset{*}{d}_{11} = \overset{*}{v}_1 = \frac{7}{16},$$

$$\overset{*}{r}_{11} = \min\left\{\frac{2}{3}, \frac{7}{16}, \max\left[\frac{2}{3} - \frac{1}{6} \cdot \frac{1}{16}, \frac{7}{16}\right]\right\} = \min\left\{\frac{2}{3}, \frac{7}{16}, \frac{39}{60}\right\} = \frac{7}{16}$$

$$\overset{*}{c}_{12} = \overset{*}{u}_1 - \overset{*}{r}_{11} = \frac{11}{48}$$

$$\overset{*}{d}_{12} = \overset{*}{v}_2 = \frac{9}{16},$$

$$\overset{*}{r}_{12} = \min\left\{\frac{11}{48}, \frac{9}{16}, \max\left[\frac{11}{48} - O, \frac{9}{16}\right]\right\} = \frac{11}{48}$$

etc.

so that

$$\overset{*}{R}_2 = \frac{1}{48}\begin{Vmatrix} 21 & 11 \\ 0 & 16 \end{Vmatrix}.$$

Hence

$$g(\overset{*}{R}_2) \sim -.016.$$

In this example the two bias corrections lead us to opposite conclusions for relative spread.

Example 2. Let P and Q be two organizations with three stratifications each where $p_1 = \frac{1}{2}$, $p_2 = \frac{1}{3}$, $p_3 = \frac{1}{6}$, $q_1 = \frac{1}{6}$ $q_2 = \frac{1}{2}$, $q_3 = \frac{1}{3}$ and

$$R = \frac{1}{10} \begin{Vmatrix} 2 & 4 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 2 \end{Vmatrix}.$$

By the methods used in example 1 we find that

$$\overset{*}{R}_1 = \frac{1}{180} \begin{Vmatrix} 40 & 32 & 0 \\ 23 & 22 & 0 \\ 21 & 6 & 36 \end{Vmatrix}$$

and

$$\overset{*}{R}_2 = \frac{1}{60} \begin{Vmatrix} 24 & 0 & 0 \\ 4 & 11 & 0 \\ 0 & 9 & 12 \end{Vmatrix}.$$

We then find the relative height and relative spread numbers as given in Table 1.

TABLE 1

	g	f
R	.062	—.200
$\overset{*}{R}_1$	.225	$\frac{13}{60} \sim .217$
$\overset{*}{R}_2$	.071	

For relative spread all three tests give the same result, i.e., P has greater spread than Q. As for relative height, the unbiased matrices give a result which differs from that of the biased matrix.

Example 3. Let P and Q be two organizations with three stratifications each where $p_1 = \frac{1}{2}$, $p_2 = \frac{1}{3}$, $p_3 = \frac{1}{6}$, $q_1 = \frac{1}{6}$, $q_2 = \frac{1}{2}$, $q_3 = \frac{1}{3}$, and

$$R = \frac{1}{2} \begin{Vmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{Vmatrix} .$$

We find

$$R_1^* = \frac{1}{6} \begin{Vmatrix} 0 & 0 & 2 \\ 0 & 0 & 1 \\ 3 & 0 & 0 \end{Vmatrix}$$

and

$$R_2^* = \frac{1}{6} \begin{Vmatrix} 2 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 3 \end{Vmatrix} .$$

From these we get Table 2.

TABLE 2

	g	f
R	0	0
R_1^*	$-\frac{2}{9}$	$\frac{1}{6}$
R_2^*	$-\frac{2}{9}$	

If we had had no process for removing bias, we would conclude from Table 2 that the two organizations have the same relative height and the same relative spread. But the corrected matrices, R^*_1 and R^*_2 indicate that P is higher than Q whereas Q has greater spread than P.

Example 4. Let P and Q be two organizations with four stratifications each where

$$p_1 = \frac{1}{3}, p_2 = \frac{1}{4}, p_3 = \frac{1}{6}, p_4 = \frac{1}{4},$$

$$q_1 = \frac{1}{3}, q_2 = \frac{1}{6}, q_3 = \frac{1}{6}, q_4 = \frac{1}{3},$$

and

$$R = \frac{1}{10}\begin{Vmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 2 \end{Vmatrix}.$$

Then

$$R_1^* = \frac{1}{480}\begin{Vmatrix} 27 & 9 & 9 & 27 \\ 9 & 35 & 43 & 33 \\ 0 & 16 & 20 & 12 \\ 108 & 36 & 24 & 72 \end{Vmatrix}$$

and

$$R_2^* = \frac{1}{120}\begin{Vmatrix} 9 & 9 & 0 & 0 \\ 6 & 8 & 16 & 0 \\ 12 & 0 & 0 & 0 \\ 9 & 7 & 8 & 36 \end{Vmatrix}.$$

These along with R give the numbers found in Table 3.

TABLE 3

	g	f
R	1.528	.300
R_1^*	— .043	.450
R_2^*	— .965	

From Table 3 we conclude that P is higher than Q with or without removal of bias. On the other hand both corrected matrices indicate that Q has greater spread than P, whereas the original uncorrected matrix indicates that P has greater spread than Q.

These examples show the importance of the bias-removing processes and also indicate that each method for removing bias has value. If one is interested only in the height of an organization measured by our function f (cf. (8)) the first method is adequate and much simpler than the second. However, if one is also interested in spread as measured by our function f (cf. (12)) the second method seems preferable, in spite of the additional labor.

9. Some Transitive Orderings

We have seen that the order $\underset{h}{>}$ introduced in Section 3 is neither transitive nor complete, and this remains true even after bias corrections have been made. If P and Q are two organizations with common members we define

$$r(P,Q) = f(R^*) \tag{58}$$

whereas R^* is given either by (24) or by (44) (57), and if P and Q have no common members we set $h(P,Q) = O$. We can now extend $\underset{h}{>}$ into a complete order by the definition $P \underset{h}{\geqslant} Q$ if and only if $h(P,Q) \geqslant O$. Since each number r_{ij} is a ratio the function $h(P,Q)$ is dimensionless. Hence, we can use not only its sign but also its value. We next consider ways of utilizing this function of pairs of organizations to obtain functions of a single organization, which can be used in turn to give a complete, transitive order. We call such an order relation a *chain order.*

Suppose that there are k organizations $P^{(1)}, \ldots, P^{(k)}$ in a given community and set $h_{ij} = h(P^{(i)}, P^{(j)})$. We introduce the function

$$H(P^i) = \frac{1}{k-1} \sum_{j=1}^{k} h_{ij}, \tag{59}$$

and the order relation $P \underset{H}{\geqslant} Q$ to mean that $H(P) \geqslant H(Q)$. The purpose of the normalizing factor $\frac{1}{(k-1)}$ is to permit intercommunity comparisons and can be omitted if only one community is involved. For example, we might wish to say that Rotary was relatively higher in city A than in city B and with this normalizing factor we could merely compare the H functions computed for Rotary in each community. The factor is $\frac{1}{(k-1)}$ rather than $\frac{1}{k}$ since h_{ii} is always O.

Although this order is complete and transitive there is a major flaw in it. It could happen that H(P) is smaller than H(Q) not because P was lower than Q but because Q had a greater excess of nearby lower organizations than P. For example we might have the following situation. Take $k = 5$ and suppose that

$$(60) \qquad \| h_{ij} \| = \begin{Vmatrix} 0 & .5 & 0 & 0 & 0 \\ -.5 & 0 & .3 & .4 & .6 \\ 0 & -.3 & 0 & .2 & .3 \\ 0 & -.4 & -.2 & 0 & .1 \\ 0 & -.6 & -.3 & -.1 & 0 \end{Vmatrix}$$

where the values h_{13}, h_{14}, h_{15} are zero because $P^{(1)}$ does not overlap $P^{(3)}$, $P^{(4)}$, $P^{(5)}$. Our intuitive feeling would be that $P^{(1)}$ was the highest organization in the community whereas $H(P^1) = .125$ and $H(P^2) = .2$.

This objection does not apply if the distribution of organizations in a community is uniform.

A possible modification would be to change the normalizing factor from $\frac{1}{k-1}$ to $\frac{1}{k_i}$ where k_i is the number of other organizations with which $P^{(i)}$ has common members, i.e.,

$$(61) \qquad H_1(P^{(i)}) = \frac{1}{k_i} \sum_{j=i}^{k} h_{ij}$$

In our example this would give

$$(\ldots, H_1(P^{(j)}), \ldots) = (.5, .2, .067, -.17, -33),$$

which is more in accordance with our intuition.

However, if instead of (60) we had

$$(62) \qquad \| h_{ij} \| = \begin{Vmatrix} 0 & 2 & 0 & 0 & 0 \\ -.2 & 0 & .3 & .4 & .6 \\ 0 & -.3 & 0 & .2 & .3 \\ 0 & -.4 & -.2 & 0 & .1 \\ 0 & -.6 & -.3 & -.1 & 0 \end{Vmatrix}$$

we would get $H_1(P^{(1)}) = .2$ and $H_1(P^{(2)}) = .275$ contrary to our intuitive feeling.

A further possibility for utilizing the numbers h_{ij} would be the following. Introduce numbers

$$k_{in} = \sum (h_{i\lambda} - h_{j\lambda}) \tag{63}$$

where the sum is over all λ for which $P^{(n)}$ has members in common with $P^{(i)}$ and also has members in common with $P^{(j)}$. Next define $P^{(i)} \underset{H_2}{\geqslant} P^{(j)}$ to mean that $k_{ij} \geqslant 0$. Thus in example (60) we get

$$\| k_{ij} \| = \begin{Vmatrix} 0 & 1 & .8 & .9 & 1.1 \\ -.1 & 0 & 1.1 & 1.8 & 2.3 \\ -.8 & -1.1 & 0 & .7 & 1.2 \\ -.9 & -1.8 & -.7 & 0 & .5 \\ -1.1 & -2.3 & -1.2 & -.5 & 0 \end{Vmatrix} . \tag{64}$$

This gives the order $P^{(1)} \underset{H_2}{>} P^{(2)} \underset{H_2}{>} P^{(3)} \underset{H_2}{>} P^{(4)} \underset{H_2}{>} P^{(5)}$ which our intuition calls for.

We see that this method will give a chain order if there is a simultaneous permutation of the rows and columns of the matrix $\| k_{ij} \|$ which leads to a matrix with positive elements above the diagonal.

On the other hand the example

$$\| h_{ij} \| = \begin{Vmatrix} 0 & 1 & 0 & -1 \\ -1 & 0 & 1 & 0 \\ 0 & -1 & 0 & 1 \\ 1 & 0 & -1 & 0 \end{Vmatrix} \tag{65}$$

gives

$$\| k_{ij} \| = \begin{Vmatrix} 0 & 2 & 0 & -2 \\ -2 & 0 & 2 & 0 \\ 0 & -2 & 0 & 2 \\ 2 & 0 & -2 & 0 \end{Vmatrix} \tag{66}$$

and this time the order H_2 is not transitive.

However, this example may not correspond to any social reality and it is possible that the H_2 order might work out quite well in practice, especially if the set of organizations includes some (such as the American Legion) which spread over the entire community. Indeed a practical modification of this order might be given by applying (63) with the summation limited to several large organizations which have high spread.

It would seem desirable to test these various methods in actual situations. Although none of them is perfect in theory, some of them may turn

out to be quite useful in practice, and this can only be determined by experiment.

10. Conclusion and Summary

It would appear that the mathematical explorations thus far carried out give promise of enabling us to map community organizations by means of their common members. What is now needed is empirical research in which the various suggested modes of analysis are tried out. We have not gone any further with the measurement of spread, for instance, because we were not sure that the empirical importance of the subject would justify the attempt to give this property transitivity as between communities. If it turns out that, at least within a given community, we can map organizations successfully, we will have laid a basis for the next step—the study of the patterns of interaction among groups as that is related to community welfare.

The purpose of this paper has been to lay the groundwork for the mapping of organizations in the influence space of the community. A mathematical model has been developed for expressing the height and the spread of organizations. This model has been based upon two assumptions: (1) that organizations can be internally stratified, and (2) that persons tend to participate in organizations at levels that reflect their general community status.

In sections 2 and 3 we have discussed a method for comparing different organizations on the basis of the relative positions of their common members. Before this method is ready for empirical testing it is desirable to build in some features which will care for certain deficiencies in the basic assumptions.

In connection with assumption (1), if the internal stratifications are not into strata of equal size then our method of comparison is biased. A major portion of this paper has been devoted to a mathematical solution of the bias problem.

If the words "tend to" could be deleted from assumption (2) then the measures of relative height given in Sections 2 and 3 would be transitive. In Section 9 we have suggested a variety of ways in which one can take proper account of the statistical nature of assumption (2) and end up with a satisfactory transitive height ordering.

A PLAN FOR SOCIOMETRIC STUDIES IN A LONGITUDINAL PROGRAMME OF RESEARCH IN CHILD DEVELOPMENT

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INTRODUCTION

The Institute of Child Study is 27 years old (13). In 1953 a federal mental health grant was made for the purpose of studying those factors which influence the development of mental health of children. Coincident with this the Board of Governors of the University of Toronto made available the gracious residence of the late Leighton McCarthy (Canadian Ambassador to the U.S.A.) to the Institute.

Here, in September, 1953, the Institute opened its nursery school for children two and a half to five, and elementary school for children from five to Grade III (to be expanded to grades IV, V, VI in successive years). At present 109 children are enrolled in class groups of 15 to 20. They are at school from 9 to 2.30 lunching with the staff and resting in their classrooms. The appearance of the school is that of a pleasant home and the atmosphere is one which the staff considers salutary for mental health, in which psychologically sound education is expressed through informality and interest. A nominal fee of $150 a year is charged and the children for the most part come from professional and business homes. This selective factor is reflected in the fact that the average I.Q. is about 118 and as high as 160+ in some cases. To be enrolled a child must be in good physical and mental health. Nevertheless, a wide range of disturbances and difficulties that are part of well children's development are encountered.

Although the schools are under the direction of their well-qualified principals and teachers, perhaps a unique feature of the Institute is that all members of the Institute staff and students, whether they be directors, researchers, parent educationists or University teachers (3), have some share in the life of the children (2); thus even the directors are invited to lunch, and a junior research assistant is better known in the kindergarten as an entertaining flautist than as a fledgling statistician. This results in the fact that although research is conducted according to the rigors of scientific method, it reflects continually the influence of associa-

tion with lively children. Life amongst them saves the researcher from becoming too esoteric or abstract.

The Research Programme (9)

The main purpose of the research programme is to study the development of the child in terms of those qualities which influence his mental health. This is defined by the director, W. E. Blatz, as *psychological security* (1, 11).

Social development is an important aspect of mental health and a most useful instrument for probing it is sociometry. The writer's particular problem has therefore been to establish a plan by which a child's sociometric qualities may be appraised from time to time over a period of several years and to record these in such a way that they may be related to other known aspects of the child. As it is hoped that most children will remain in the school over many years, and as age groups are promoted as a whole each year, the groups will remain as constant as possible during the research period.

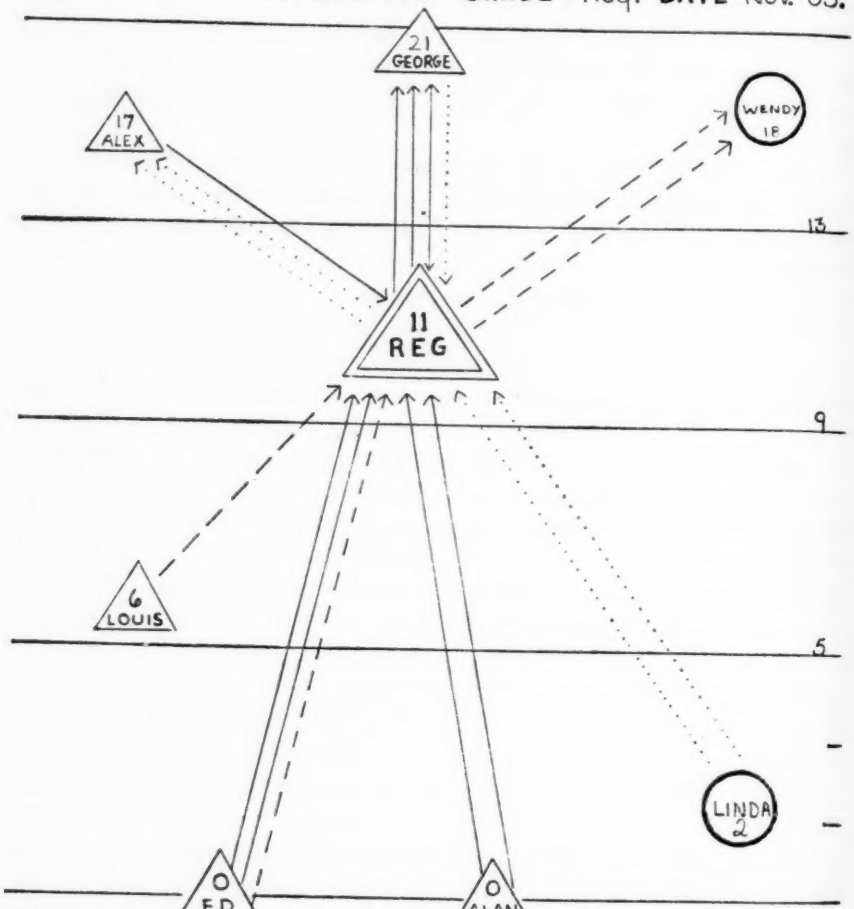
Our basic data are collected through administering a standard form of a three-criteria three-choice sociometric test to each group of children fall and spring. These are of course given verbally and individually and in most cases included with some other testing or "games". The results are scored, recorded and analyzed in the conventional way and depicted on a sociogram divided into tertiles (4).

As we have stated elsewhere (4) although a great deal of value has come out of the development of a scoring system in sociometry, the interest which has resulted in sociometric status has often obscured the essence of sociometry, namely that its focus is on relationships. "Scores which are statistically identical are rarely sociometrically equivalent" (4, p. 26). Our belief is that the evolution of a child's sociometric pattern may provide a better clue into his mental health than is given by his sociometric status. However in returning our focus to the study of patterns we want to take advantage of the progress which has been made in refining statistical procedures and to incorporate their assets as one important aspect of the patterns. As we are interested not merely in the pattern at one time but in its evolution we hope to compile our data so that we may be able to record and study this.*

* The philosophy implied in this statement is not specific to our sociometric studies but basic to other areas. Thus it is in the item analysis of intelligence test

SOCIOMETRIC PATTERN

NAME – REG. SCHOOL – I.C.S. GRADE – Kdg. DATE – NOV. '53.



Number choices received 11 Number of different people choosing - 6
Number choices made 7 Number of different people chosen - 3
People reciprocated 2
Average status of choosers 7·7. Range 0-21. Status of chosen 18·6. Range 17-21

DIAGRAM I

Our technical problems therefore have been (1) to devise a means by which patterns may be analyzed, and (2) to devise a means by which these may be compared from time to time. The methods so far developed are as follows:

A. *Depicting an Individual's Sociometric Pattern* (Diagrams I and II)

This procedure was reached after working out the patterns of more than 100 children in the Toronto public schools. In consultation with teachers, students and colleagues cooperating in the project we gradually modified various suggested ideas into the following procedure.

(1) A page is divided horizontally into four equal parts. The dividing lines correspond to the points at which scores from a sociometric test are significantly above chance, at chance, and significantly below. Working from the data as set out in a standard sociometric matrix or summary sheet the following steps are taken:

(2) The subject whose pattern is being considered is placed on this diagram at the place where his sociometric score falls. He is represented by a double triangle if a male, a double circle if a female.

(3) Each individual who is chosen by the subject and each who chooses the subject is represented by a circle or triangle and placed on the diagram according to his sociometric status.

(4) Each first choice made by or to the subject is shown by a solid line; each second by a broken line and each third by a dotted line. (It is possible of course by the use of colours to indicate on which criterion the choice was made.) An arrowhead shows in which direction the choice was made.

(5) The choices between the individuals making up the subjects' constellation may be included in a similar fashion.

(6) At the bottom of the sheet space is given for entering relevant data such as: Number of individuals chosen by the subject; number of individuals choosing the subject; number of reciprocals; average and range of status of chosen; average and range of status of the choosers.

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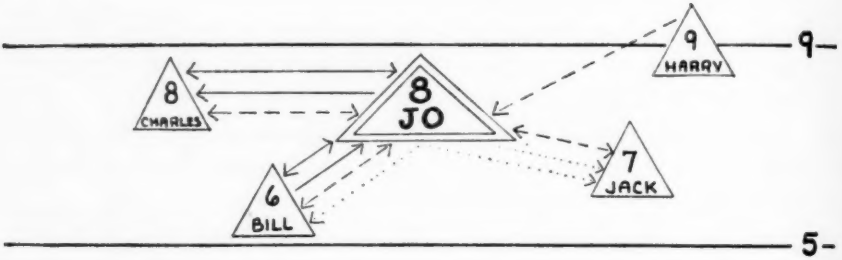
rather than in the gross score. in the form of the child's ability in reading or numbering rather than the absolute level of achievement that we are interested. The fundamental question changes from one of "how much?" to one of "what kind?" We believe that if the "personality is unique" it deserves to be studied in its uniqueness and not in its similarities to other personalities.

SOCIOMETRIC PATTERN

NAME- JOE SCHOOL- I.C.S. GRADE- KDG. DATE- NOV.'53



Number choices received 8. Number of different people choosing 4.
Number choices made 9. Number of different people chosen 3.
People reciprocated 3.
Average status of choosers 7.5. Range 6-9.
Average status of chosen 7. Range 6-8.

DIAGRAM II

This gives in one diagram all the sociometric data of a single individual from a single test and sets it forth with fair accuracy and clarity. It is easy to compare the diagram of one child's pattern with that of another and as the two examples used as illustrations show, to see their similarities and differences.

B. *Individual's cumulative sociometric records* (Diagram III)

A practical problem which occurs in all cumulative studies is that of space. Not only do filing cases become cluttered, but unless data are recorded in compact form they become increasingly difficult to work with as the years go by. Therefore consideration has been given carefully to conciseness with relevancy. Presuming that the study is continued for the five years there will be a minimum of ten tests for each child. Records therefore have been devised by which all the data for one child on one test are set forth and can be readily compared with the data from successive tests. To

INDIVIDUAL CUMULATIVE SOCIOMETRIC FORM

NAME - Req. DATE - NOV. '53.

SCORE	CHOSEN BY	FOR	CHILD	CHOOSES	FOR	SCORE
21	GEORGE	103		GEORGE	111	21
17	ALEX	001		ALEX	033	17
6	LOUIS	200				
2	LINDA	033	11			
0	ED	112				
0	ALAN	011				
				WENDY	202	18
7.7.	6.	335	R.2.	3		18.6

DATE - MARCH '54

DIAG. 3

be able to see what changes and what remains constant about him is of prime consideration.

This type of form originated from a three-year study of nursery school children (10), and has been organized in its present form by my associate, Lindsay Duthie.

Diagram III shows the present form. A sheet is set up to record four test results. Thus the results of these tests can be seen at a glance. In entering the data the following steps are taken:

(1) The child's score is placed in the center column at the level relative to chance: significantly above; significantly below; or around chance.
(2) All those choosing him are placed on the left by name in order of their sociometric test and the criterion and position each chose him *for* is entered. To illustrate: Reg is chosen by George whose status is 21 as first choice on the first criterion and third on the third.
(3) Those whom the child chooses are placed to the right with the criterion and position indicated and the chosens' status. Thus Reg chooses George first on each of the criteria.
(4) At the bottom is given a summary of these data. These are self-explanatory in the diagram. The "R" is the number of reciprocals.
(5) Data from subsequent tests are entered in successive forms. By coding (e.g. encircling in colour) it is simple to see which children's names have appeared on different tests, and to enter by symbols change in the relationship as increasing or decreasing in intensity.

Progress to Date

Since our new school of the Institute was opened in September, a sociometric test has been given in all grades and two tests, four months apart, to the children in nursery school and kindergarten. Data have been recorded into individual patterns and also entered on the cumulative record sheets.

These data have already been made use of in a study (12) relating sociometric status to motor skills and a study (6) relating sociometric status to creativity. They have also been used in preliminary case studies of children of similar sociometric status who differ in sociometric patterns and in preliminary studies of interaction of children with their friends and non-friends (5, 7). They have also been incorporated into routine use for case work with the individual children, and are considered useful as com-

plementary to intelligence, achievement and personality tests in diagnosis and therapy.

Future Directions

Although *our* major interest is to trace the change in sociometric patterns of children over a five-year period and to relate these to our total knowledge of each child, there are several other possibilities for using data which have been organized in this way. These, it is envisioned, may be adopted by colleagues and graduate students.

I. *Types:* It is obvious that these patterns may be sorted into types (8). Thus one may attempt to classify "open" and "closed" patterns; or "climbers" (those who choose above themselves) and "pullers" (those who choose below); or "superficial" (receiving a lot of third choices) and "deep" (receiving first choices). Once such classifications are made it is a simple matter using one or more characteristics of the pattern to relate these to other known characteristics of the individual—intelligence, age, economic status, religion, school marks, etc., etc. Such approach lends itself neatly to accepted experimental design and offers researchers at the M.A. and Ph.D. a wealth of hypotheses.

II. *Sociometric structure:* It is obvious that by studying the total sociometric information obtained each year in each grade, it will be possible to ascertain to what extent structures remain constant at different age levels regardless of differing individuals (10). For example, is a degree of sex cleavage typical of kindergarten sociometric structure or does it depend on the individuals making up a kindergarten group of a particular year?

III. *The Whole Child:* Another method falls betwixt the scientific and clinical approach. This is the consideration of the individual's sociometric pattern in relation to all the other known facts about *him*. These other facts include his performance on standardized intelligence, achievement and personality tests including an item analysis of these; his experience as revealed by projectives; descriptive assessment by his teachers and parents, and clinical appraisal by the psychologist. These are considered not only at one time but as he grows and as they change from year to year. Results from such an approach do not immediately lend themselves to neat experimental design. They do, however, enable us to see the child functioning as a whole and how such functioning is reflected in his sociometric pattern.

IV. *Study of the action of individuals of similar sociometric status*

but different sociometric patterns: What is the difference in social action between two children such as Reg and Jo whose sociometric patterns are shown in the above diagrams? Both boys have about average sociometric status; both are in kindergarten, differing in age by only two months; both slightly above average in I.Q., differing only by four points; both are considered normal, pleasant children by their teacher.

We have been concerned with how these boys with these different patterns differ in their actual social actions. Observations have been made of the number and content of their contacts, and the content of these in the playroom and on the playground. More specifically, their interaction with their chosen friends has been observed, and tape recorded at a special luncheon party (5). Later their interaction with each other was similarly observed at another party. Too, the teacher has been asked to have them draw a picture of themselves and their friends and to tell her about what they are doing. Also it is planned to watch their interaction with their friends and with their non-friends in the problem situation of putting a new mechanical train together and setting it running around its track. How the decision is reached as to who should "wind it up" offers a natural but superb opportunity for studying the intricacies of social interaction!

V. *Study of "Group Therapy":* It should be quite possible to make objective studies of the effect of planning groups in terms of known sociometric facts. As sociometric results are made known to the teachers and the children discussed with them it is possible to arrange lunch tables, work groups, play activities on the basis of known facts and to ascertain whether through wise use of natural situations the isolated child can be helped to make contacts and the overly social child to become more balanced. Such "group therapy" will however form merely a part in a total mental health programme as one hesitates to interfere unduly with the natural course of what we believe to be a salutary educational achievement.

Conclusion

It is intended from time to time to issue articles in this Journal and elsewhere describing the results of specific studies and giving progress reports. However we believe that the greatest potential value of our programme lies in the fact that we can trace our children's sociometric patterns as they evolve over a period of five years. These, related to the wealth of other information we will have about the children will surely provide answers to some of the besetting problems of social development, social inter-relatedness, and mental health.

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SOME EVIDENCE ON NORTHWAY'S AUTONOMIC HYPOTHESIS

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INTRODUCTION

It is almost a decade ago that Northway proposed the hypothesis to the effect that recessive children were characterised by sympathetic predominance and aggressive children by parasympathetic predominance. A brief historical account should suffice.

In 1944 Northway (1) carried out a detailed investigation of children whose sociometric scores fell into the bottom quartile of acceptance. She divided these children into two main groups, the recessive and the aggressive.

Again in 1946 tnis distinction appeared. ". . . there are two distinct causes for being low in acceptance. It may be because the individual is nondescript, simply isolated (the neglectee or recessive) or it may be because he is interfering and rejected" (2). This time, however, she adds that "Every child when confronted with a failure situation for which he has no ready action pattern will withdraw from or attack it in a way by which he endeavours to attain satisfaction. This attack behaviour if not leading to success may change into undirected attack (anger) or reverse into withdrawal. Social situations are ones for which there are few ready-made action patterns: they are often unpredictable and baffling. As the child develops and he continues to find no satisfaction, he either begins to attack blindly (aggressive behaviour) or withdraw (recessivism)."

She goes on to consider what causes either of these patterns (withdrawal or attack) to be more readily assumed in some children than in others. The hypothesis is suggested that some individuals, due to dominance of the sympathetic branch of the autonomic nervous system are apt, in situations involving failure, to withdraw from it: while those more parasympathetically dominant put forth an inefficient attack.

This hypothesis would seem to the writer to be of fundamental importance, and in the apparent absence of any attempt at verifying it the following experiment is offered.

Method

In another connection the writer administered a sociometric test to each of thirty-four complete school classes (3). Three choices in order of preference were required on each of the criteria:

sitting by in class
playing with at break
taking home to tea.

An answer was also required to the question "Whom do you like least of all in the class?" By studying the results of this test it was possible to build up two groups of individuals, a group of recessives and a group of aggressives. The recessives, twenty-eight in number, were those children who were neither chosen nor rejected by any of their classmates. Sixteen children who were disliked more frequently than they were chosen formed the aggressive group. These numbers are small because all children in the two groups must have had autonomic measurements taken. Only one hundred and twenty children out of the total of almost a thousand were therefore eligible.

We must now turn to the measurement of the balance of the autonomic nervous system. Wenger's work (4, 5, 6, 7) is concerned with the isolation and measurement of this variable in children, and later in adults.

Two measures found by Wenger to be good measures of autonomic balance were sublingual temperature and salivary pH. While it would be unwise to use only these two tests as measures of an autonomic factor it can, however, be argued that if we find that the means for the recessive group, compared with the means for the aggressive on both these variables differ significantly in the direction expected by Northway's hypothesis, then we have gone at least part of the way in substantiating it.

Sublingual temperature was measured by an ordinary clinical thermometer inserted under the tongue for thirty seconds. Salivary pH was measured by means of a pH meter (Cambridge Instrument Company). A sample of saliva of each subject was collected (by expectoration) in a stoppered test tube which was immediately placed in a large vacuum flask containing solid carbon dioxide. On return to the laboratory the sample was thawed out and its pH estimated.

Results

The means for the two groups in respect of these variables are presented below:

	Sublingual Temp.	*Salivary pH*
Aggressives (N = 16)	96.69	6.98
Recessives (N = 28)	97.08	7.03
Diff. (expected direction)	Yes	No
"t"	1.214 NS	.284 NS

From this table it will be seen that in neither case do the means differ significantly. Nor is the predicted direction maintained in each. Northway's hypothesis would on this data be therefore not supported.

Conclusions

The above experiment cannot be regarded as giving results in any way definitive. The writer did not start out with the intention of testing Northway's hypothesis. An experiment was in progress (shortly to be published in the Maudsley Monograph series) which gave rise to the above data. If the writer has succeeded in drawing attention (a) to the somewhat bold hypothesis of Northway and (b) to the fact that no adequate test of this hypothesis has yet been made, then the present note will have been worthwhile.

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BOOK REVIEW

Sherif, Muzafer, and Wilson, M.O. (Editors). *Group Relations at the Crossroads.* New York, Harper and Bros., 1953. Pp. viii + 379. $4.00.

The Second Conference on Social Psychology at the University of Oklahoma in April, 1952, was designed to be an interdisciplinary parley on "group relations," presumably relations both within and between groups. As is not uncommon, however, the thirteen contributed papers represent relatively autonomous developments of topics that are of special interest to their authors and sometimes bear only a tenuous relationship to the announced theme of the Conference. Despite the senior editor's attempt, in his introductory chapter, to bind these fragments into a whole, the book remains a series of mutually independent essays, of varying quality, on quite diverse subjects. Perhaps the best way to review the book is to summarize briefly the contents of each essay, tedious though this process may be.

Two papers are devoted primarily to infra-human social behavior. John Scott develops the ideas that heredity and "habit formation" play important parts in social relationships among animals and insects, summarizing recent experimental evidence to support his views. His scheme for classifying such relationships will be new to most social psychologists. Anselm Strauss discusses differences between human and infra-human behavior with special reference to language and "shared concepts" or group symbols as defining characteristics of human sociality.

Race relations are the main concern of papers by Anne Anastasi and Mozell Hill. Anastasi traces the history of psychometric studies of differences among ethnic groups, showing how early notions of an hereditary hierarchy of innate intelligence is slowly succumbing to an approach which stresses multiple trait differences and overlapping group membership. Hill debates the various usages of the term "social distance" and analyzes some of the problems in using Bogardus social distance scale to study Negro-white relations.

Theories of "social perception" are treated by two contributors. James Gibson re-examines Sherif's autokinetic experiment and derives from it the need for "a reasonable theory of how, and in what sense, perception is learned." He develops a "formula for learning to perceive" based on differentiation and repetition of psychophysical stimuli, and concludes that "the factor which makes for the socializing of perception . . . is the process of word-making." Gardner Murphy's paper likewise argues that the present crop of theories which assert that personality rather than physical stimuli

determine perception are in need of evaluation. But, after reviewing the evidence on some global issues, such as group membership, ego needs and the rigidity of biases, he reaches a conclusion opposite to Gibson's, namely that careful laboratory studies in a psychophysical frame of reference are not broadly enough conceived to answer important questions about social perception.

Three papers are devoted to various aspects of the behavior of group members. Leon Festinger makes a distinction between two kinds of "compliant behavior": one in which "private acceptance" accompanies "public conformity" and the other in which it does not, illustrating the distinction with several empirical studies. Launor Carter discusses some of the difficulties of defining "leadership" in small groups, and reports some findings of studies of group behavior, principally those conducted at the University of Rochester. Helen Jennings reviews some of her earlier material on sociometric choices in "living" and "working" situations, and reports some preliminary findings of a study on the connection between sociometric and sociodramatic behavior among children—a study undertaken to illuminate further the choice process.

Primary groups and reference groups are the centers of attention for two more papers. Robert Faris surveys a broad range of sociological contributions, both theoretical and empirical, to understanding the nature, variety and functions of primary groups. Sherif traces the history of the reference group concept and shows its relation to the notion of "frame of reference." He illustrates the use of "reference group" in explaining the outcome of a variety of conflict situations.

Finally, there are two papers that are hard to classify. Herbert Blumer takes social psychologists to task for using "unrealistic" analytic schemes in studying social behavior, and for failing to understand that: "the most important feature of human association is that the participants *take each other into account*." (Blumer's italics). Nelson Foote and Clyde Hart assess the process of opinion formation as it bears upon collective behavior or social action. They urge greater attention to longitudinal studies of opinion formation and illustrate some of their hypotheses about social movements with evidence from a study of the "professionalization" of labor in Detroit.

It is difficult to evaluate this book as a whole because of the great diversity not only in what the contributors attempt but also in how well they carry out their aims; but some general comments are in order. Very few of the papers report any new empirical material. Only a few undertake a

systematic re-analysis of previously reported studies. An equally small number introduce topics or information that is unfamiliar to well-trained social psychologists or sociologists. Some discussion of methodological issues appears in many of the essays and may interest some readers. Perhaps the chief merit of the book is that it acquaints the reader with the viewpoint, the personal and professional preoccupations, and the strengths and weaknesses of many prominent contemporary scholars in social psychology and related fields.

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